MXT Columns

RESTEK 2016 GC Columns

MXT® Capillary Columns

Ideal for High Temperature GC Analysis

Stainless steel MXT® columns are your best choice for high temperature chromatography or any other situation where the potential for column breakage is too high to rely on fused silica. For field instruments, process GCs, GCs with small ovens, and more, reach for robust Restek MXT® columns!

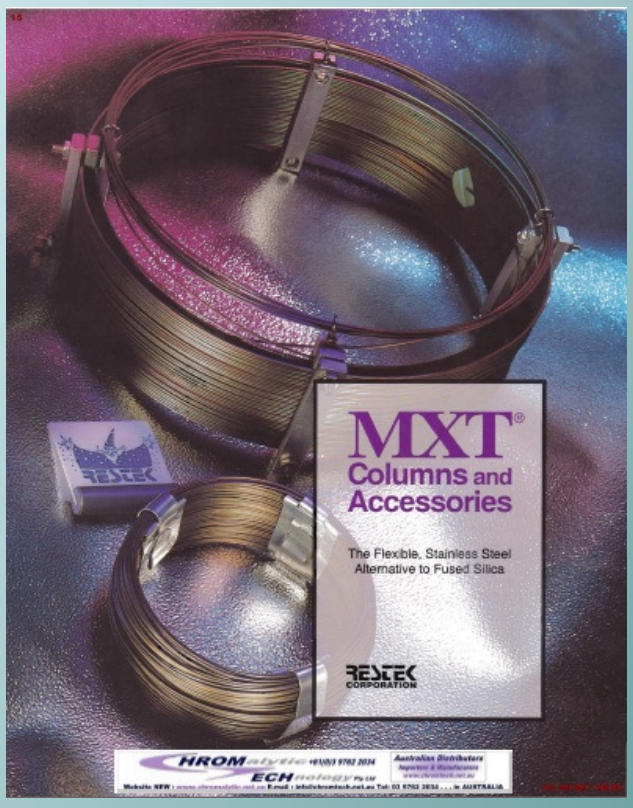
- Metal tubing won't become brittle at high temperatures (430 °C).*
- Exclusive Siltek® layer provides an internal surface with excellent inertness.
- Can be tightly coiled well under 4.5" without breaking, even under stress.

Available Liquid Phases:

MXT®-1	MXT®-65TG
MXT®-5	MXT®-Biodiesel TG
MXT®-20	MXT®-2887
MXT®-1301	MXT®-1HT SimDist
MXT®-35	MXT®-1 SimDist
MXT®-50	MXT®-500 SimDist
MXT®-200	MXT®-502.2
MXT®-1701	MXT®-Volatiles
MXT®-65	MXT®-624
MXT®-WAX	Guard tubing

Also available: MXT® PLOT columns

*Maximum temperature of finished column may vary by phase.



MXT® Capillary Columns

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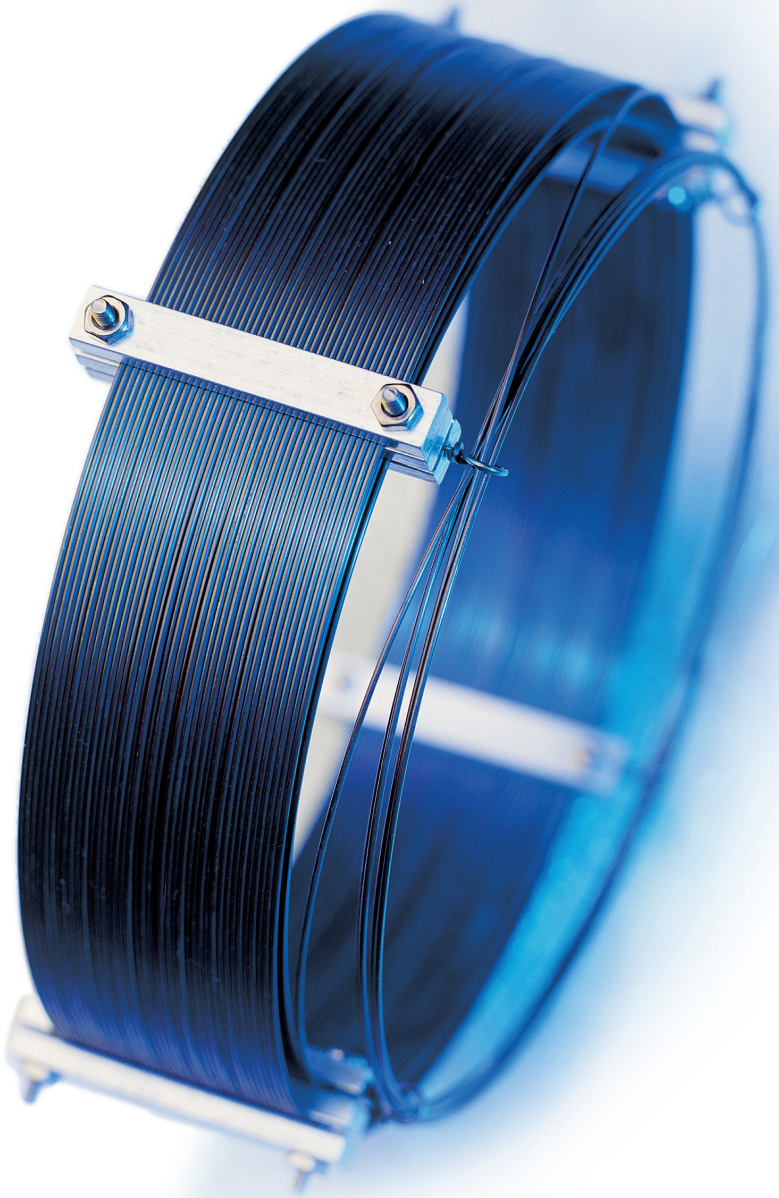

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MXT®-200	MXT®-502.2
MXT®-1701	MXT®-Volatiles
MXT®-65	MXT®-624
MXT®-WAX	Guard tubing

Also available: MXT® PLOT columns

*Maximum temperature of finished column may vary by phase.

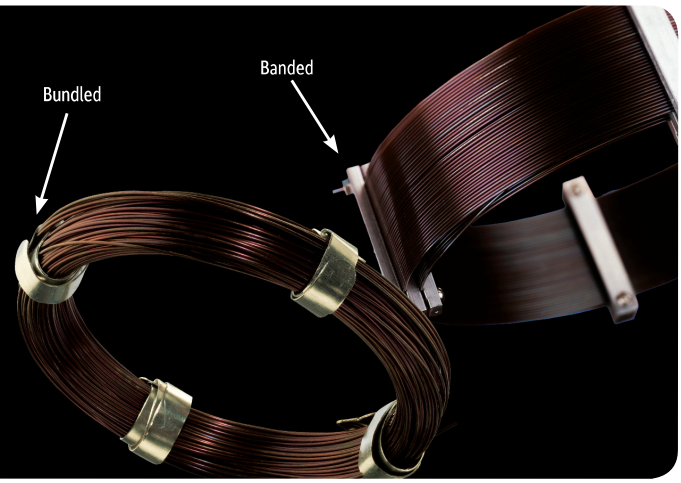
Visit **www.restek.com/mxt** for a complete listing of Restek MXT® columns!

MXT® Columns Are Sized to Order!

For your convenience, not only are MXT® columns available in the standard 4.5" coil diameter, but they also are available in 3.5" and 6" coil diameters. Whether you're using them in a process GC or a benchtop GC, our MXT® columns will be a perfect fit. Just add one of the suffix numbers below to the column part number when you order! Additional sizes and configurations may be available; call for details.

Coil Diameter	Suffix Number	Configuration*
3.5"	-273	Bundled
4.5"	None	Standard Banded
6.0"	-276	Bundled

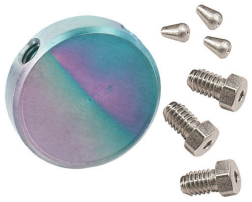
*Standard configuration may vary for PLOT columns.



Connect transfer lines or guard columns directly to your MXT® columns without compromising your data.

Rugged MXT® low-dead-volume connectors are Siltek® treated to make them inert to active compounds, just like our MXT® columns! They can be used at temperatures up to 430 °C without degrading the deactivated layer, and their low thermal mass tracks rapid oven temperature programming. Kits are available for 0.28 mm, 0.32 mm, and 0.53 mm ID columns in a standard configuration for column-to-column connections and a "Y" configuration for connecting 2 columns to 1 inlet or 1 column to 2 detectors. In addition to the MXT® union, each kit also contains stainless steel 1/32-inch ferrules and nuts.

Standard MXT® Low-Dead-Volume Connector Kit



MXT® Low-Dead-Volume "Y" Connector Kit

MXT® Low-Dead-Volume Connector Kits

Description	qty.	cat.#
For 0.28mm ID MXT Columns	kit	20397
For 0.32mm ID MXT Columns	kit	20536
For 0.53mm ID MXT Columns	kit	20394

MXT® Low-Dead-Volume "Y" Connector Kits

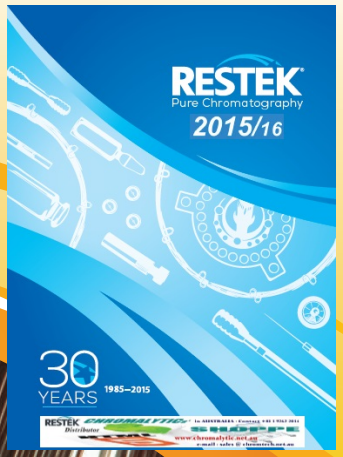
Description	qty.	cat.#
For 0.28mm ID MXT Columns	kit	20396
For 0.32mm ID MXT Columns	kit	20537
For 0.53mm ID MXT Columns	kit	20395

Contact your Restek representative and order yours today!

Visit **www.restek.com/Contact-Us** to find a distributor or representative.

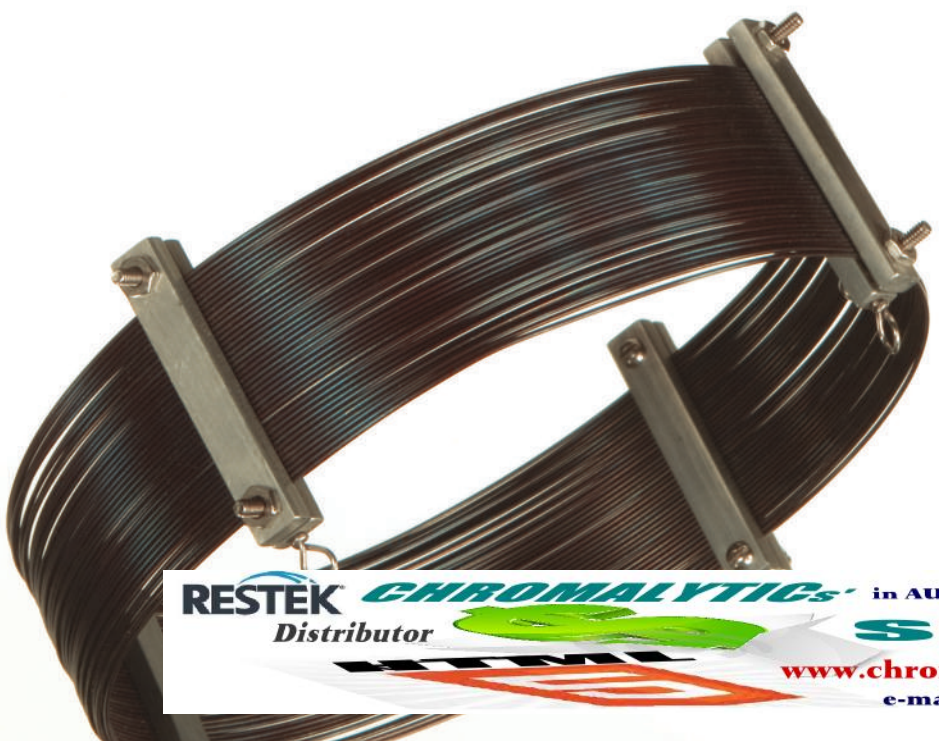
RESTEK®

Lit. Cat.# GNTS1368A



GC Columns

Metal MXT® Capillary Columns

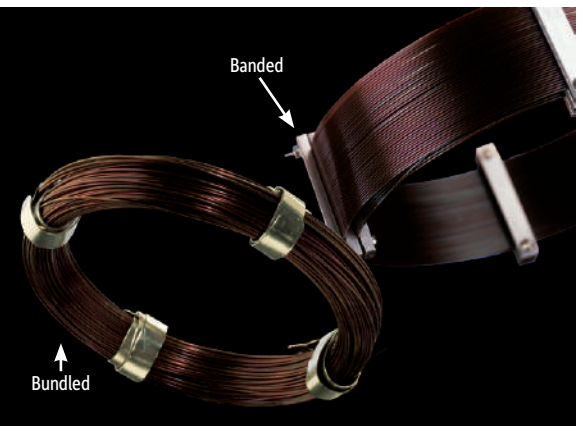


What is an MXT® column?

MXT® columns are wall coated open tubular (WCOT) columns made from stainless steel tubing that has had the internal surface treated with an exclusive Siltek® treatment. This treatment makes the surface as inert as deactivated fused silica, and it allows us to treat the tubing with a wide variety of polymer phases. The unique Siltek® treatment also enables us to offer MXT® columns in a wide range of internal diameters, including 0.18 mm, 0.25 mm, 0.28 mm, 0.32 mm, and 0.53 mm. Because the Siltek® treatment permeates the stainless steel surface, rather than simply coating it, the layer is exceptionally flexible, so the tubing can be coiled to very small diameters. The standard coil diameter for most MXT® columns is 4.5", but they also are available in 3.5" and 6" coil diameters.

Whether you're using them in a process GC or a benchtop GC, our MXT® columns will be a perfect fit. Just add the proper suffix number in the table to the column part number when you order!

Coil Diameter	Suffix Number	Configuration
3.5"	-273	Bundled
4.5"	None	Standard Banded
6.0"	-276	Bundled

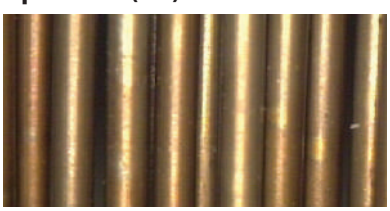


Additional sizes and configurations may be available; call for details.
Note that the minimum coil diameter for 0.53 mm ID columns is 2.5 inches, and the minimum coil diameter for 0.25 mm ID columns is 1.5 inches.

MXT® columns are your best choice for high temperature analyses and situations in which the potential for column breakage is high. Here's why:

- Metal tubing allows MXT® comlumns to be used to higher temperatures (430 °C) than fused silica columns (standard rating is 360 °C). This is because the polyimide resin that encases the fused silica becomes brittle over time at high temperatures. MXT® columns do not become brittle or break.
- Inertness of MXT® columns and fused silica columns is similar, due to the unique properties of the Siltek® surface treatment.
- Metal columns can be coiled under 4.5 inches without breaking, making them ideal for small instruments.
- Coating efficiency (plates/meter) of MXT® columns is similar to that of fused silica.
- MXT® columns will not break under stress, making them perfect for process GCs and field instruments.

MXT®-Biodiesel TG columns are undamaged by high thermal cycles compared to high-temperature (HT) fused silica columns, which break down under the same conditions.



MXT®-Biodiesel TG columns are undamaged by high thermal cycles.

HT fused silica columns, labeled as stable to 430 °C, show pitting and breakdown.

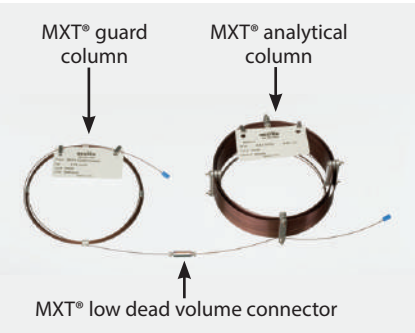
100 temperature cycles to 430 °C totaling 500 minutes at maximum temperature.

MXT ideal for high-temperature analyses

Custom MXT® columns are also available.

If you do not see the column you need listed in the following pages, contact Customer Service and we will be happy to help.

Connect MXT® columns using an MXT® low dead volume connector!



Connect transfer lines or guard columns directly to your MXT® columns without compromising your data.

Rugged MXT® low dead volume connectors are Siltek® treated to make them inert to active compounds, just like our MXT® columns! They can be used at temperatures up to 430 °C without degrading the deactivated layer, and their low thermal mass tracks rapid oven temperature programming. Kits are available for 0.28 mm, 0.32 mm, and 0.53 mm ID columns in a standard configuration for column-to-column connections and a "Y" configuration for connecting two columns to one inlet or one column to two detectors. In addition to the MXT® union, each kit also contains stainless steel 1/32-inch ferrules and nuts. (See page 232 for more details.)

Intermediate-Polarity Deactivated MXT® Guard/Retention Gap Columns/ Transfer Lines (passivated stainless steel)

- Useful for a wide range of applications.
- Compatible with most common solvents.
- Maximum temperature: 325 °C.

Nominal ID	Nominal OD	5-Meter cat.#	5-Meter (6-pk.) cat.#	10-Meter cat.#
0.28 mm	0.56 ± 0.025 mm	70044	70044-600	70046
0.53 mm	0.74 ± 0.025 mm	70045	70045-600	70047

did you know?

Certificates of analysis for 5 m and 10 m Restek® guard columns are provided electronically. To view and download your 5 m or 10 m guard column certificate, simply visit **www.restek.com/documentation** then enter your catalog # and serial #.

Hydroguard®-Treated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

- Extend analytical column lifetime by preventing degradation from harsh "steam-cleaning" water injections.
- Maximum temperature: 325 °C.

When transfer lines from purge-and-trap systems, air monitoring equipment, or other instruments carry condensed water vapor, deactivated column tubing quickly becomes active because of the creation of free silanol groups. These silanol groups adsorb active oxygenated compounds, such as alcohols and diols.

Restek chemists have addressed this concern and found a solution—Hydroguard® deactivated tubing. A unique deactivation chemistry creates a high-density surface that is not readily attacked by aggressive hydrolysis. The high-density surface coverage of the Hydroguard® deactivation layer effectively prevents water vapor from reaching the surface beneath. Use Hydroguard® tubing for connecting GCs to:

- Headspace analyzers.
- Air analysis equipment and concentrator units.
- Purge-and-trap systems.

Nominal ID	Nominal OD	5-Meter cat.#	10-Meter cat.#	30-Meter* cat.#
0.28 mm	0.56 ± 0.025 mm	70080	70083	70086
0.53 mm	0.74 ± 0.025 mm	70081	70084	70087

*30-meter lengths are banded in 5-meter sections.
Diameters greater than 0.10 mm are tested with the Grob test mix to ensure high inertness.

also available

Column connector kits & ferrules

See **page 232.**

MXT®-1 Columns (Siltek®-treated stainless steel)

(nonpolar phase; Crossbond® dimethyl polysiloxane)

- General-purpose columns for solvent impurities, PCB congeners (e.g., Aroclor mixes), gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, and oxygenates.
- Temperature range: -60 °C to 430 °C.
- Equivalent to USP G1, G2, G38 phases.
- 4.5" standard coil diameter.

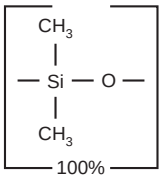
MXT®-1 columns exhibit long lifetime and very low bleed at high operating temperatures. A proprietary synthesis process eliminates residual catalysts that could cause degradation and increase bleed.

ID	df	temp. limits*	6-Meter cat.#	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
0.25 mm	0.10 µm	-60 to 360/430 °C		70105	70116	70117	70114
	0.25 µm	-60 to 360/430 °C		70120	70123	70126	70129
	0.50 µm	-60 to 330/400 °C		70135	70138		
	1.00 µm	-60 to 320/360 °C		70150	70153	70156	70159
0.28 mm	0.10 µm	-60 to 360/430 °C	70102	70106	70109		
	0.25 µm	-60 to 360/430 °C		70121	70124	70127	
	0.50 µm	-60 to 400 °C			70139	70142	
	1.00 µm	-60 to 320/360 °C		70151	70154	70157	
	3.00 µm	-60 to 285/360 °C		70181	70184	70187	
0.53 mm	0.15 µm	-60 to 360/430 °C	70101	70107			
	0.25 µm	-60 to 360/430 °C		70122	70125	70128	
	0.50 µm	-60 to 330/400 °C		70137	70140	70143	
	1.00 µm	-60 to 320/360 °C		70152	70155	70158	
	1.50 µm	-60 to 310/360 °C		70167	70170	70173	
	3.00 µm	-60 to 285/360 °C		70182	70185	70188	70189
	5.00 µm	-60 to 270/360 °C		70177	70179	70183	
	7.00 µm	-60 to 240/360 °C		70191	70192	70193	

ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#
0.18 mm	0.20 µm	-60 to 330/430 °C	71811	71812	71813
	0.40 µm	-60 to 320/400 °C		71815	71816

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-1 Structure



Similar to: (100%-methyl)-polysiloxane

similar phases

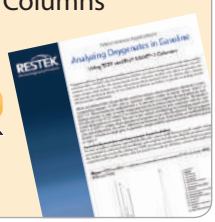
DB-PS1, UAC-1, UAC-1MS

free literature

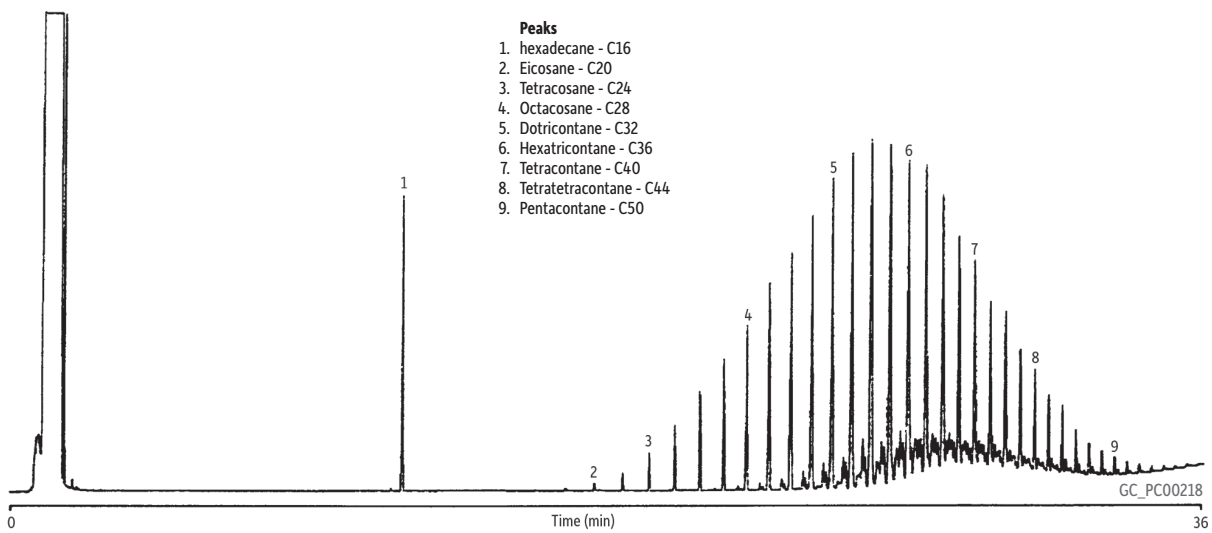
Analyzing Oxygenates in Gasoline Using TCEP and Rtx®-1/MXT®-1 Columns

Download your free copy from www.restek.com

lit. cat.# 59587A

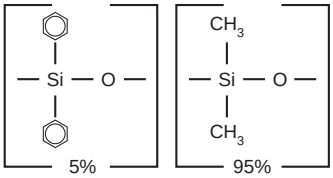


Petroleum Wax on MXT®-1



Column	MXT®-1, 30 m, 0.28 mm ID, 0.25 µm (cat.# 70124)
Sample	Petroleum wax
Diluent:	cyclohexane
Conc.:	0.1% w/w
Injection	
Inj. Vol.:	1.0 µL cold on-column
Oven	
Oven Temp.:	50 °C to 400 °C at 10 °C/min (hold 10 min)
Carrier Gas	H_2, constant flow
Linear Velocity:	60 cm/sec @ 50 °C
Detector	FID @ 400 °C
Notes	FID sensitivity: 64 x 10^{-11} AFS

MXT®-5 Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-PS5, VF-5ht UltiMetal, UAC-5, UAC-5MS

also available

Metal MXT® PLOT Columns

See **page 129.**

MXT®-5 Columns (Siltek®-treated stainless steel)

(low-polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

- General-purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners (e.g., Aroclor mixes), essential oils, and semivolatiles.
- Temperature range: -60 °C to 430 °C.
- Equivalent to USP G27, G36 phases.
- 4.5" standard coil diameter.

The diphenyl dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the MXT®-5 polymer, providing a tight monomodal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	-60 to 330/430 °C	70205	70208	
	0.25 µm	-60 to 360/430 °C	70220	70223	70226
	0.50 µm	-60 to 330/360 °C	70235	70238	70241
	1.00 µm	-60 to 310/340 °C	70250	70253	
0.28 mm	0.25 µm	-60 to 340/430 °C	70221	70224	70227
	0.50 µm	-60 to 315/400 °C	70236	70239	
	1.00 µm	-60 to 310/360 °C	70251	70254	70257
	3.00 µm	-60 to 290/360 °C	70281	70284	
0.53 mm	0.25 µm	-60 to 340/430 °C	70222	70225	70228
	0.50 µm	-60 to 330/400 °C	70237	70240	
	1.00 µm	-60 to 310/360 °C	70252	70255	70258
	1.50 µm	-60 to 300/360 °C	70267	70270	
	3.00 µm	-60 to 290/360 °C	70282	70285	70288
	5.00 µm	-60 to 270/360 °C	70277	70279	70283

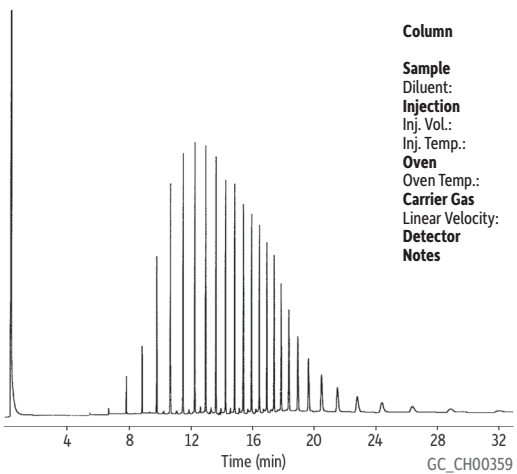
ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#
0.18 mm	0.20 µm	-60 to 325/430 °C	71821	71822	71823
	0.40 µm	-60 to 315/400 °C	71824	71825	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8

Siloxane (Polysiloxane 20) on MXT®-5



Column	MXT®-5, 15 m, 0.28 mm ID, 0.25 µm (cat.# 70221)
Sample	Polysiloxane 20
Diluent:	Pentane
Injection	
Inj. Vol.:	1.0 µL split (split ratio 100:1)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	75 °C to 340 °C at 15 °C/min
Carrier Gas	H_2, constant flow
Linear Velocity:	40 cm/sec
Detector	FID @ 340 °C
Notes	FID sensitivity: 16 x 10^{-11} AFS

MXT®-50 Columns (Siltek®-treated stainless steel)

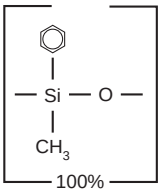
(midpolarity phase; Crossbond® phenyl methyl polysiloxane)

- General-purpose columns for pesticides, herbicides, rosin acids, phthalate esters, and sterols.
- Temperature range: 0 °C to 300 °C.
- Equivalent to USP G3 phase.
- 4.5" standard coil diameter.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.53 mm	0.83 µm	0 to 280/300 °C		70569	
	1.00 µm	0 to 260/280 °C	70552	70555	70558
	1.50 µm	0 to 250/280 °C		70570	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-50 Structure



Similar to: (50%-phenyl)-methylpolysiloxane

MXT®-1301 Columns (Siltek®-treated stainless steel)

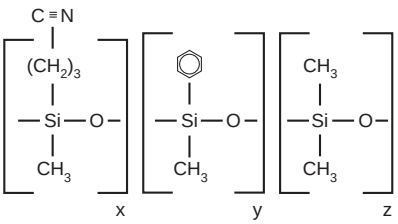
(low- to midpolarity phase)

- General-purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G43 phase.
- 4.5" standard coil diameter.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.53 mm	1.00 µm	-20 to 260/280 °C		76055	
	3.00 µm	-20 to 240/280 °C	76082	76085	76088

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-1301 Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

MXT®-1701 Columns (Siltek®-treated stainless steel)

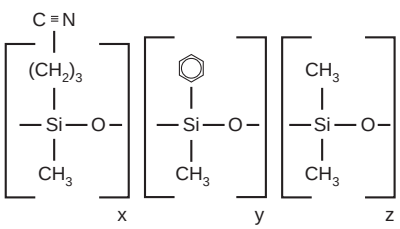
(midpolarity Crossbond® phase)

- General-purpose columns for alcohols, oxygenates, PCB congeners (e.g., Aroclor mixes), and pesticides.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G46 phase.
- 4.5" standard coil diameter.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	-20 to 280 °C	72020	72023	
	1.00 µm	-20 to 260 °C		72053	
0.28 mm	1.00 µm	-20 to 260 °C	72051		
	1.50 µm	-20 to 250 °C	72066		
0.53 mm	0.50 µm	-20 to 270/280 °C		72040	
	1.00 µm	-20 to 260 °C	72052	72055	
	1.50 µm	-20 to 250 °C		72070	
	3.00 µm	-20 to 240 °C	72082	72085	72088

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-1701 Structure

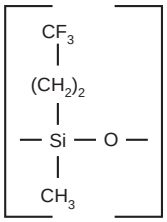


Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-PS1701

MXT®-200 Structure



Similar to: (trifluoropropyl)-methylpolysiloxane

MXT®-200 Columns (Siltek®-treated stainless steel)

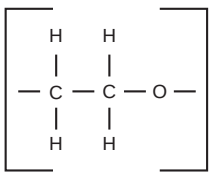
(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

- General-purpose columns for solvents, Freon® fluorocarbons, alcohols, ketones, silanes, and glycols. Excellent confirmation column with an Rtx®-5 column, for phenols, nitrosamines, organochlorine pesticides, chlorinated hydrocarbons, and chlorophenoxy herbicides.
- Temperature range: -20 °C to 400 °C.
- Equivalent to USP G6 phase.
- 4.5" standard coil diameter.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.50 µm	-20 to 400 °C		75038	
	1.00 µm	-20 to 310/360 °C		75053	
0.53 mm	1.00 µm	-20 to 290/360 °C	75052	75055	75058
	1.50 µm	-20 to 280/360 °C		75070	75073
	3.00 µm	-20 to 260/360 °C	75082	75085	75088

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-WAX Structure



similar phases

DB-PSWAX, UAC-CW

MXT®-WAX Columns (Siltek®-treated stainless steel)

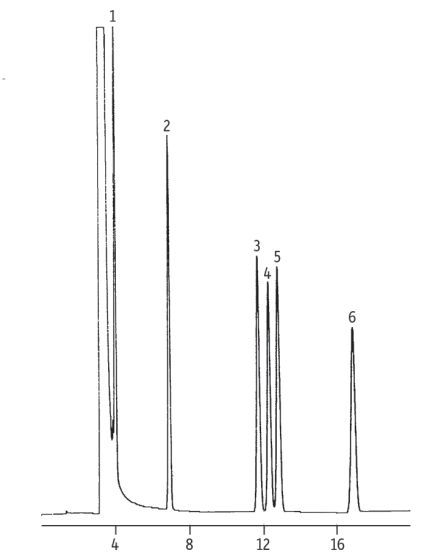
(polar phase; Crossbond® Carbowax® polyethylene glycol—provides oxidation resistance)

- General-purpose columns for FAMEs, flavor compounds, essential oils, amines, solvents, xylene isomers, and U.S. EPA Method 603 (acrolein/acrylonitrile).
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.
- 4.5" standard coil diameter.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	40 to 250/260 °C	70620	70623	
	0.50 µm	40 to 260 °C		70638	
0.28 mm	0.25 µm	40 to 250/260 °C		70624	
	0.50 µm	40 to 250/260 °C		70639	70642
	1.00 µm	40 to 240/250 °C	70651	70654	70657
0.53 mm	0.25 µm	40 to 250/260 °C	70622	70625	
	0.50 µm	40 to 250/260 °C	70637	70640	
	1.00 µm	40 to 240/250 °C	70652	70655	70658
	1.50 µm	40 to 230/250 °C	70666	70669	70672
	2.00 µm	40 to 220/250 °C	70667	70670	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Aromatics (Benzene/Toluene/Xylene) on MXT®-WAX



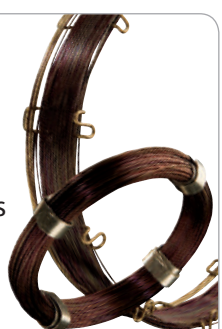
Peaks
1. Benzene
2. Toluene
3. Ethylbenzene
4. *p*-Xylene
5. *m*-Xylene
6. *o*-Xylene

Column	MXT®-WAX, 30 m, 0.28 mm ID, 1.00 µm (cat.# 70654)
Sample	BTEX Standard (cat.# 30051)
Injection	
Inj. Vol.:	1.0 µL split (split ratio 100:1)
Inj. Temp.:	260 °C
Oven	
Oven Temp.:	60 °C
Carrier Gas	H_2, constant flow
Linear Velocity:	38 cm/sec
Detector	FID @ 260 °C
Notes	FID sensitivity: 3.2 x 10^{-11} AFS

also available

Metal MXT® PLOT Columns

See **page 129.**



Volatile Organics Analysis

MXT®-502.2 Columns (Siltek®-treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants, cited in U.S. EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks. Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Temperature range: -20 °C to 320 °C.
- 4.5" standard coil diameter.

An MXT®-502.2 column will enable you to quantify all compounds listed in U.S. EPA Methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-502.2 stationary phase provides low bleed and thermal stability to 320 °C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling.

ID	df	temp. limits*	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
0.25 mm	1.40 µm	-20 to 270/320 °C		70916	
0.28 mm	1.60 µm	-20 to 250/320 °C	70919		
0.53 mm	3.00 µm	-20 to 250/320 °C	70908	70909	70910

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

similar phases

DB-PS502.2

MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8

MXT®-Volatiles Columns (Siltek®-treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Temperature range: -20 °C to 320 °C.
- 4.5" standard coil diameter.

MXT®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in U.S. EPA Methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-Volatiles stationary phase provides low bleed and thermal stability to 320 °C.

ID	df	temp. limits*	30-Meter cat.#	60-Meter cat.#
0.28 mm	1.25 µm	-20 to 280/320 °C	70924	70926
0.53 mm	2.00 µm	-20 to 280/320 °C	70925	70927
	3.00 µm	-20 to 250/320 °C	70922	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

also available

Column connector kits & ferrules

See **page 232.**

MXT®-624 Columns (Siltek®-treated stainless steel)

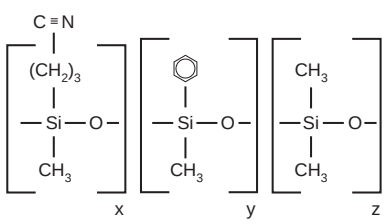
(low- to midpolarity phase)

- Application-specific columns for volatile organic pollutants. Recommended in U.S. EPA methods for volatile organic pollutants.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G43 phase.
- 4.5" standard coil diameter.

The unique polarity of "624" columns makes them ideal for analyses of volatile organic pollutants. Although the MXT®-502.2 column is recommended in many methods, MXT®-624 columns offer the best separation of the early-eluting gases.

ID	df	temp. limits	30-Meter cat.#	60-Meter cat.#
0.25 mm	1.40 µm	-20 to 240/280 °C	70968	70969
0.53 mm				

MXT®-624 Structure



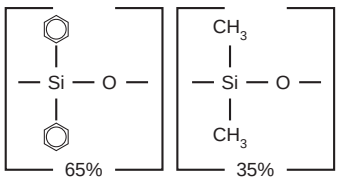
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-PS624, UAC-624

Triglycerides in Foods Analysis

MXT®-65TG Structure



Similar to: (65%-phenyl)-methylpolysiloxane

similar phases

UAC-65HT

MXT®-65TG Columns (Siltek®-treated stainless steel)
(high-polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

- Application-specific columns, specially tested for triglycerides.
- Stable to 370 °C.
- 4.5" standard coil diameter.

The MXT®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370 °C thermal stability, an MXT®-65TG column should not be used for analyses of compounds that contain active oxygenated groups.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.10 µm	20 to 370 °C	77005	77008
0.53 mm	0.10 µm	20 to 370 °C	77007	77010

free literature

MXT® Capillary Columns: Ideal for High Temperature GC Analysis

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lit. cat.# GNTS1368A

MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8

Biodiesel Fuels Analysis

MXT®-Biodiesel TG Columns (Siltek®-treated stainless steel)

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Stable at 430 °C for reliable, consistent performance.

Description	temp. limits	3.5" Coil cat.#	7" diameter 11-pin cage cat.#
14 m, 0.53 mm ID, 0.16 µm with 2 m Integra-Gap*	-60 to 380/430 °C	70289-273	70289
10 m, 0.32 mm ID, 0.10 µm	-60 to 380/430 °C	—	70292
10 m, 0.32 mm ID, 0.10 µm with 2 m x 0.53 mm Retention Gap**	-60 to 380/430 °C	—	70290
15 m, 0.32 mm ID, 0.10 µm	-60 to 380/430 °C	—	70293
15 m, 0.32 mm ID, 0.10 µm with 2 m x 0.53 mm Retention Gap**	-60 to 380/430 °C	—	70291
2 m x 0.53 mm MXT Biodiesel TG Retention Gap	-60 to 430 °C	—	70294

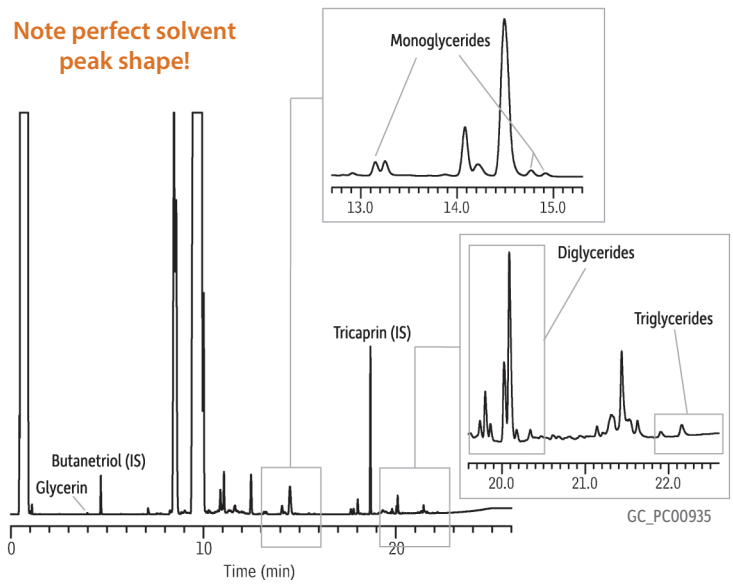
*Total column length = 16 meters.
**Connected with low dead volume MXT connector.

similar phases

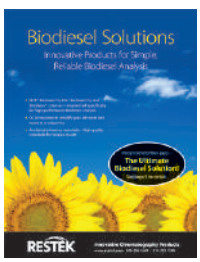
MET-Biodiesel

ASTM D6584 Derivatized B100 and Internal Standards on MXT®-Biodiesel TG

Note perfect solvent peak shape!



Column	MXT®-Biodiesel TG w/2 m x 0.53 mm retention gap, 10 m, 0.32 mm ID, 0.10 µm (cat.# 70290)
Sample	B100 + IS butanetriol & tricaprin derivatized with MSTFA as per ASTM D6584
Injection	
Inj. Vol.:	1.0 µL cold on-column
Temp. Program:	Oven track
Oven	
Oven Temp.:	50 °C (hold 1 min) to 180 °C at 15 °C/min to 230 °C at 7 °C/min to 430 °C at 30 °C/min (hold 5 min)
Carrier Gas	H_2, constant flow
Flow Rate:	4 mL/min
Detector	FID @ 430 °C



free literature

Biodiesel Solutions: Innovative Products for Simple, Reliable Biodiesel Analysis

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lit. cat.# PCFL1409-UNV

Simulated Distillation Analysis (C5-C44)

MXT®-2887 Column (Siltek®-treated stainless steel)
(nonpolar phase; Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

- Application-specific columns for simulated distillation.
- Stable to 400 °C.
- 4.5" standard coil diameter.

MXT®-2887 columns' stationary phase, column dimensions, and film thicknesses have been optimized to exceed the resolution and skewing factor requirements specified in ASTM Method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times. Manufactured from Siltek®-treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available.

ID	df	temp. limits	10-Meter cat.#
0.53 mm			

similar phases

DB-PS2887

free literature

Rtx®-2887/ MXT®-2887
Restek's Capillary GC Columns for Simulated Distillation of Petroleum Fractions

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lit. cat.# 59567B

similar phases

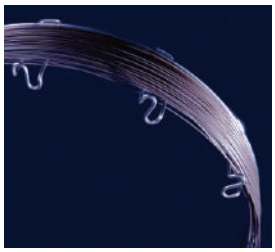
DB-HT SimDis ProSteel, CP-SimDist UltiMetal, ZB-1X SimDist

Method Recommended Columns

ASTM Method	Hydrocarbon Range	cat. #	Configuration
D2887	C5–C44	70131	5 m x 0.53 mm, 0.88 µm
		70132	10 m x 0.53 mm, 2.65 µm
D7213 (D2887-ext)	C5–C60	70131	5 m x 0.53 mm, 0.88 µm
		70115	5 m x 0.53 mm, 0.20 µm
		70112	5 m x 0.53 mm, 0.10 µm
D5307	crude up to C42	70115	5 m x 0.53 mm, 0.20 µm
D6352	C10–C90	70112	5 m x 0.53 mm, 0.10 µm
		70115	5 m x 0.53 mm, 0.20 µm
D7096	gasoline up to C14	70132	10 m x 0.53 mm, 2.65 µm
		10177	15 m x 0.53 mm, 5 µm
D7500	C7–C110	70112	5 m x 0.53 mm, 0.10 µm
		70115	5 m x 0.53 mm, 0.20 µm
D7169	C5–C100	70112	5 m x 0.53 mm, 0.10 µm
		70115	5 m x 0.53 mm, 0.20 µm

Simulated Distillation Analysis (C5-C110)

MXT®-1HT SimDist Column (Siltek®-treated stainless steel)
(nonpolar phases)

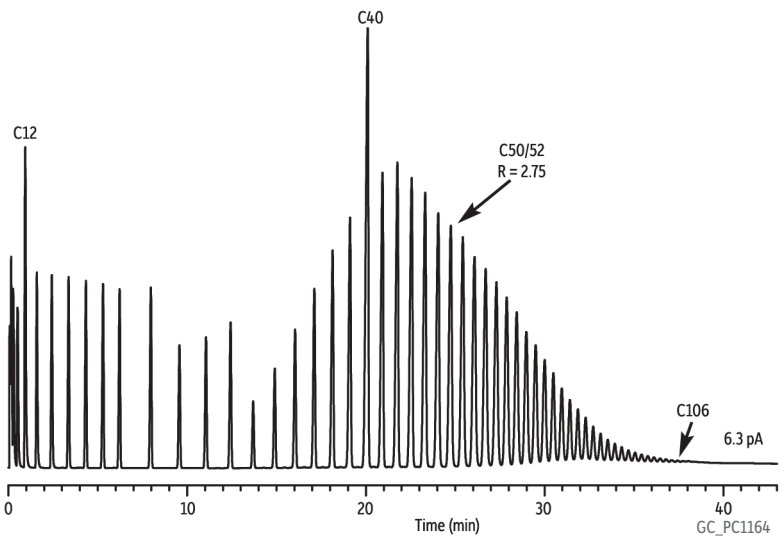


- Stable up to 450 °C—lowest bleed for longest column lifetime.
- Reliably meets all ASTM D6352, D7169, and D7500 specifications.
- 100% dimethyl polysiloxane phase allows easy comparisons to historical data.
- Individually tested for guaranteed performance.
- 7" coil diameter.

Accurate boiling point determination for medium and heavy fractions using GC simulated distillation requires columns and phase polymers that are robust enough to withstand high temperatures without significant degradation.

ID	df	temp. limits	5-Meter cat.#	10-Meter cat.#
0.53 mm	0.10 µm	-60 to 430/450 °C	70112	
	0.20 µm	-60 to 400/430 °C	70115	
	0.21 µm	-60 to 400/430 °C		70118
	0.88 µm	-60 to 380/430 °C	70131	70134
	1.00 µm	-60 to 380/400 °C		70130
	1.20 µm	-60 to 380/380 °C		70119
	2.65 µm	-60 to 360/400 °C		70132
	5.00 µm	-60 to 360/400 °C		70133

Hydrocarbons (C5-C106) on MXT®-1HT SimDist at 450 °C



Peaks	t_R (min)
1. C5	—
2. C6	—
3. C7	—
4. C8	—
5. C9	—
6. C10	—
7. C11	—
8. C12	0.938
9. C13	1.586
10. C14	2.425
11. C15	3.365
12. C16	4.332
13. C17	5.290
14. C18	6.217
15. C20	7.966
16. C22	9.566
17. C24	11.051
18. C26	12.426
19. C28	13.689
20. C30	14.897
21. C32	16.035
22. C34	17.110
23. C36	18.133
24. C38	19.108
25. C40	20.096
26. C42	20.923
27. C44	21.759
28. C46	22.556
29. C48	23.317
30. C50	24.051
31. C52	24.752
32. C54	25.422
33. C56	26.079
34. C58	26.701
35. C60	27.305
36. C62	27.878
37. C64	28.439
38. C66	28.975
39. C68	29.499
40. C70	30.002
41. C72	30.489
42. C74	30.906
43. C76	31.414
44. C78	31.862
45. C80	32.294
46. C82	32.719
47. C84	33.132
48. C86	33.529
49. C88	33.927
50. C90	34.310
51. C92	34.689
52. C94	35.059
53. C96	35.423
54. C98	35.773
55. C100	36.120
56. C102	36.463
57. C104	36.793
58. C106	37.118

Column MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.10 µm (cat.# 70112)
Sample Custom C5-C106 hydrocarbon standard
Diluent: Carbon disulfide
Conc.: 1%
Injection
Inj. Vol.: 0.5 µL cold on-column
Temp. Program: 53 °C to 450 °C at 10 °C/min (hold 5 min)
Oven
Oven Temp.: 50 °C to 450 °C at 10 °C/min (hold 5 min)
Carrier Gas
Flow Rate: 18 mL/min

Detector FID @ 450 °C
Make-up Gas Flow Rate: 24 mL/min
Constant Column + Constant Make-up: 42 mL/min
Make-up Gas Type: N_2
Data Rate: 20 Hz
Instrument Shimadzu 2010 GC

MXT®-500 SimDist Column (Siltek®-treated stainless steel)
(nonpolar phase)

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation.
- Stable to 430 °C.
- 4.5" standard coil diameter.

ID	df	temp. limits	6-Meter cat.#
0.53 mm	0.15 µm	-60 to 420/430 °C	70104

Polywax® Calibration Materials

Description	qty.	cat.#
Polywax 655 calibration material	1 g	36225
Polywax 1,000 calibration material	1 g	36227

similar phases

UAC-DX30

free literature

GC Analysis of Petroleum Products by Simulated Distillation, Using MXT® SimDist Columns

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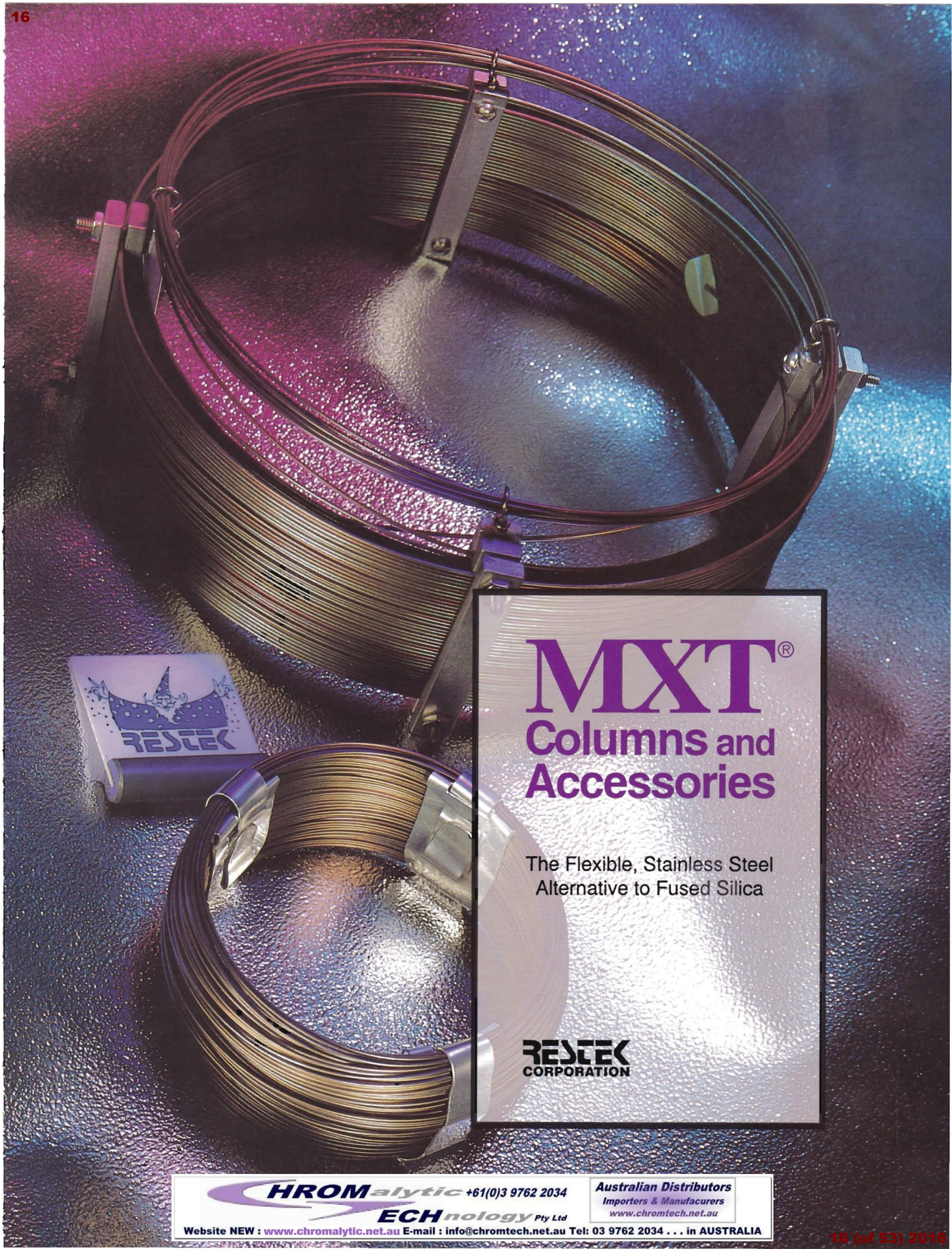
lit. cat.# 59551A



MXT® Columns

The New Generation of Flexible, Inert Stainless Steel Capillary Columns

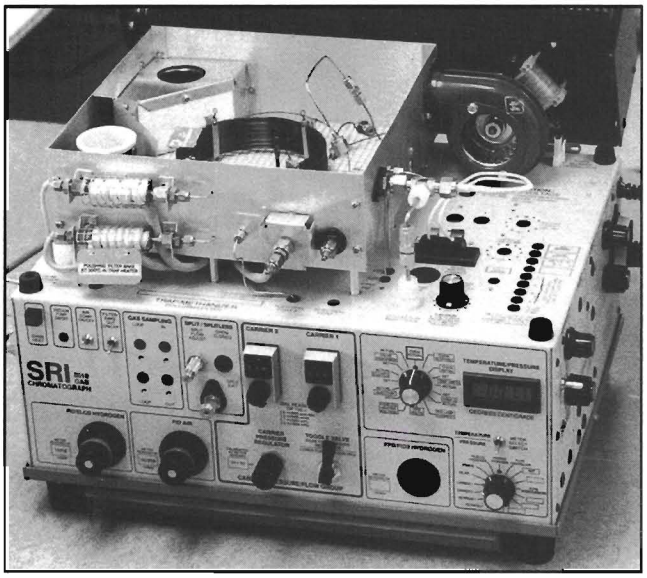
Stainless steel columns have been used in capillary gas chromatography since 1957. Metal columns were extremely rugged and flexible, but suffered from poor inertness. Improvements in inertness were made with the advent of glass capillary columns. However, this increased inertness was obtained at the expense of flexibility. With the introduction of polyimide coated fused silica in 1979, a column material was finally available to chromatographers that provided the flexibility of stainless steel plus superior inertness. With fused silica columns, polyimide is coated on the outside of the tubing to increase the tubing strength. However, at oven temperatures greater than 360°C, polyimide shrinks and becomes brittle, leading to spontaneous column breakage under normal stress. Although columns exist with aluminum cladding or higher temperature polyimides, spontaneous breakage and limited thermal stability still pose key problems. With the development of MXT® columns in 1991, an inert capillary column that could be operated at higher temperatures without the fear of breakage became reality.

MXT® stainless steel capillary columns are made inert by bonding a micron layer of deactivated fused silica to the interior tubing wall. This inert tubing is known as Silcosteel®. The Silcosteel® is further passivated using high temperature capillary column deactivation techniques. Once the surface is fully deactivated, the same stationary phases that are commonly available with fused silica capillary columns can be bonded onto the Silcosteel® surface to yield the new MXT® capillary columns.

Both fused silica and stainless steel MXT® capillary columns offer a high degree of inertness and flexibility. Stainless steel MXT® columns have the added advantage of being resistant to abrasion, scratches and spontaneous breakage. The flexible thin-walled stainless steel tubing used for MXT® columns is as easy to cut as polyimide coated fused silica tubing. The stainless steel tubing also prevents *uv* induced stationary phase degradation of polyethylene glycol and cyanosilicone polymers when exposed to sunlight. MXT® columns are preferred when using smaller coil diameters (3½" for MXT® columns vs. 7.65" for fused silica columns) commonly used in portable gas chromatographs or process control applications.

Since price and performance are similar, the deciding factor in whether to use fused silica or metal columns is often the degree of thermal stability, shock resistance, and ruggedness required for your particular analysis. Under harsh operating conditions, MXT® capillary columns are the best choice.

Table of Contents



MXT® columns are ideal for small ovens, portable GCs, process analyzers, or GC/MS systems used for on-site monitoring hazardous waste facilities.

MXT® Column Cross-Section

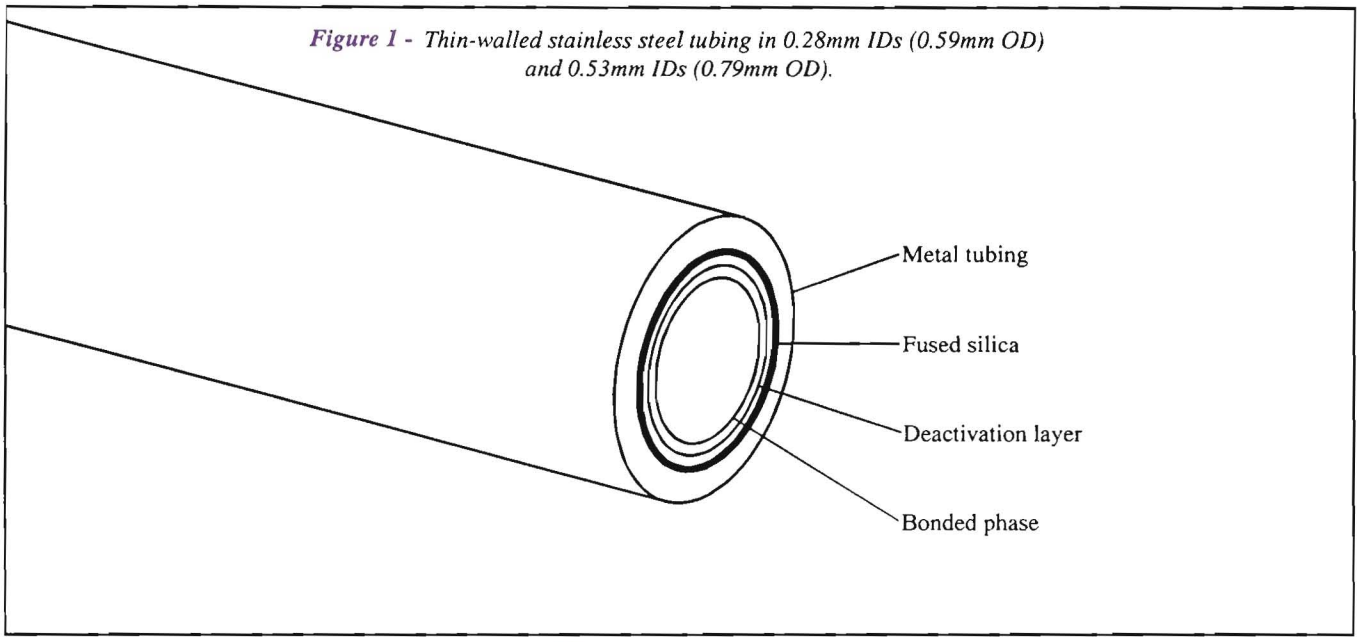


Figure 1 - Thin-walled stainless steel tubing in 0.28mm IDs (0.59mm OD) and 0.53mm IDs (0.79mm OD).

Commonly Asked Questions. . .

What are MXT® columns?

MXT® columns are made by depositing a uniform, micron layer of flexible fused silica on the inner surface of stainless steel. The surface is then deactivated and made inert by the same process used to treat our Crossbond® fused silica columns. A static coating and bonding process allows us to make columns in a wide variety of polarities.

What advantages do MXT® columns offer?

MXT® columns were developed to increase the utility of capillary chromatography. They offer combined benefits of fused silica and stainless steel capillary columns such as:

- High degree of inertness to active sample components
- Extreme flexibility without risk of spontaneous breakage
- No loss in tubing strength when continually heated above 400°C
- Rapid and uniform heat transfer
- Rugged, unaffected by abrasions or scratches
- Smaller coil diameter (3½" for MXT® columns vs. 7.65" for fused silica)
- Equivalent pricing to fused silica columns

What are MXT® columns made from?

MXT® columns are made from thin-walled stainless steel tubing in 0.28mm and 0.53mm IDs. The tubing is half hard temper, so it springs back in place much like fused silica.

Why are MXT® columns easy to use?

- MXT® columns can be installed directly into most instruments without any modification or pre-column adaptor.
- Both the 0.28mm and 0.53mm ID columns can be installed using conventional 0.8mm graphite ferrules.
- The inside diameter of the 0.53mm ID column is large enough to allow a standard 26 gauge needle to be inserted for on-column injections.
- MXT® columns are easily cut using a small file that is included with each column or a standard ceramic wafer.
- MXT® columns are ideal for small ovens, portable GCs, process analyzers, or GC/MS systems used for on-site monitoring hazardous waste facilities

Note: The technique used to cut MXT® columns is similar to that of fused silica tubing, but more deliberate pressure is required. Once the tubing is scored, it snaps cleanly with properly applied force. MXT® tubing should be handled similarly to polyimide coated fused silica tubing. Sharp kinks or bends less than 1-inch in radius must be avoided. However, MXT® columns can withstand much more rugged operating conditions than fused silica.

MXT® Column Characteristics

Inertness

MXT® Columns Offer Comparable Inertness to Fused Silica Columns

Fused silica tubing is an extremely inert column material. It contains less than 5ppm of metal oxides and other contaminants and is very inert to active compounds. Fused silica also has a very smooth inner surface as shown by the scanning electron micrograph (SEM) in Figure 2. This smooth surface permits even stationary phase coatings and high column efficiencies. In comparison, untreated stainless steel contains hydrocarbons, metal oxides, and other contaminants that can adsorb active compounds. In addition, a stainless steel surface has many folds or ridges that are often several microns deep (Figure 3). This rough surface makes it difficult to coat stationary phases evenly, resulting in poor peak symmetry and low column efficiencies. MXT® (Silcosteel®) tubing is made by depositing a micron layer of fused silica over the rough stainless steel metal surface. Figure 4 shows an SEM of an MXT® (Silcosteel®) surface prior to deactivation or coating. Figure 4 also shows areas where the fused silica lining was selectively removed to expose the untreated stainless steel surface below. The SEM clearly illustrates how the fused silica deposition (Silcosteel® process) smooths the rough stainless surface. This smooth surface allows stationary phases to be coated with minimal loss of efficiency and renders the metal inactive, giving a high degree of inertness towards active compounds. The active sites are completely covered, creating essentially the same inner surface as a fused silica capillary column.

Silcosteel® Inertness is Demonstrated Using the Grob Test Mixture

Column inertness can be evaluated through the use of the Grob test mixture. The Grob test mixture contains a wide variety of functional groups that give discrete information about column inertness. Peak symmetry of polar compounds such as alcohols, aldehydes, and ketones are indicators of column inertness. Hydroxyl groups, commonly found in alcohols and diols, easily interact with any material in the sample flow path that has the ability to hydrogen bond. In severe cases, adsorption of polar compounds can become so pronounced that the compounds completely disappear. Hydrocarbons in the Grob test mixture act as reference peaks for the active compounds and polarity indicators. Fatty acid methyl esters are used to calculate column efficiency.

In Figure 5, 1.0µl of the Grob test mixture (5ng per component on-column) is injected on a 15m, 0.32mm ID, 0.25µm Stabilwax® column. Column inertness is indicated by the excellent response and peak symmetry of the active sample components, 2,3-butanediol and 1-octanol (peaks 4 and 5). To examine the inertness of fused silica tubing, a 5-meter piece of deactivated, fused silica guard column was butt-connected to the Stabilwax® column. Figure 6 shows that no difference in column inertness was

Figure 2 - A scanning electron micrograph illustrates the surface characteristics of fused silica

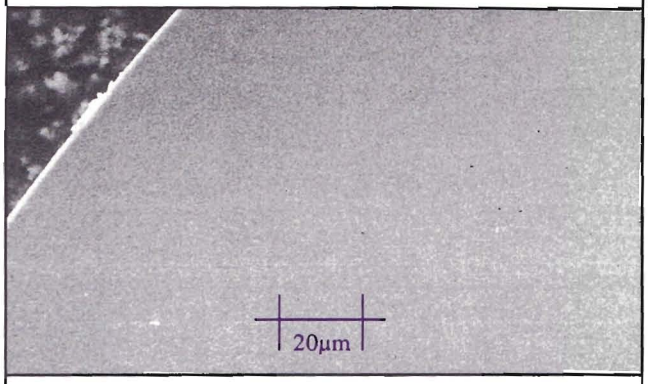


Figure 3 - A scanning electron micrograph illustrates the surface characteristics of stainless steel

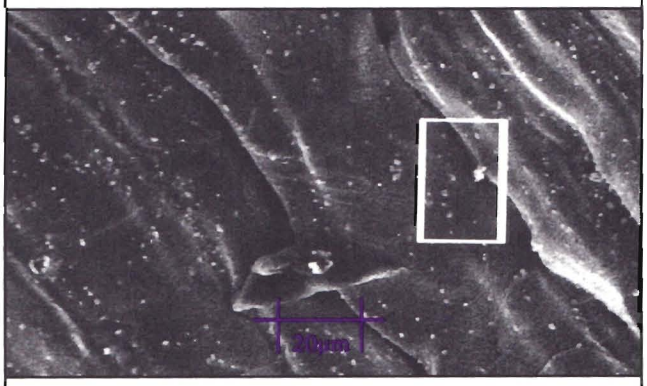
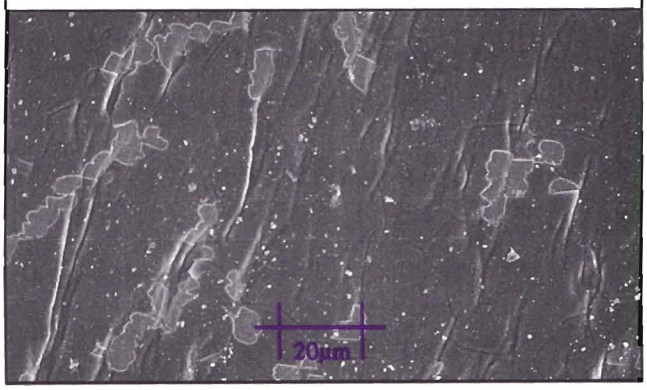


Figure 4 - A scanning electron micrograph illustrates the surface characteristics of MXT® (Silcosteel®) tubing



observed; compared to the Stabilwax® column. In Figure 7, a 5-meter piece of cleaned, untreated stainless steel tubing was butt-connected to the Stabilwax® column. The bare stainless steel irreversibly adsorbs the active compounds 2,3-butanediol, 1-octanol, nonanal, and 2,6-dimethylaniline (peaks 4, 5, 3, and 10), making it useless for trace level work.

By modifying the stainless steel surface, inertness can be improved. Figure 8 shows a 5-meter piece of Silcosteel® tubing butt-connected to the Stabilwax® column. Notice the increased inertness and peak symmetry of the 2,3-butanediol and 1-octanol on the Silcosteel® tubing compared to the bare stainless steel tubing.

***Figures 5, 6, 7 & 8** - demonstrate the relative inertness of different column materials with the Grob test mixture*

Figure 5 - A Stabilwax® column shows good inertness to active sample components

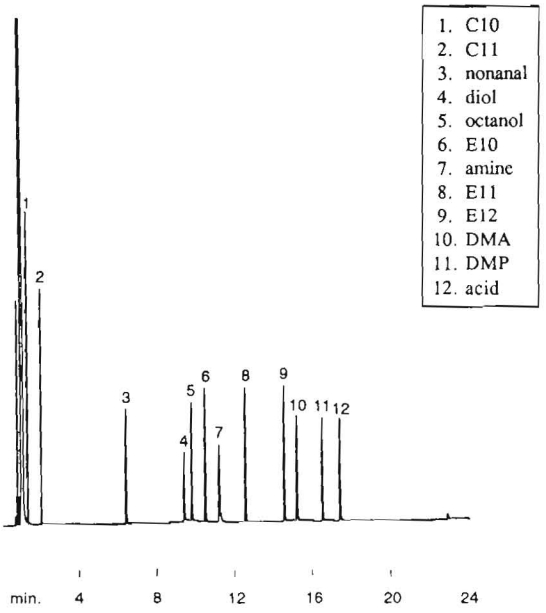


Figure 6 - The inertness of the Stabilwax® column is unchanged when a 5-meter fused silica guard column is attached

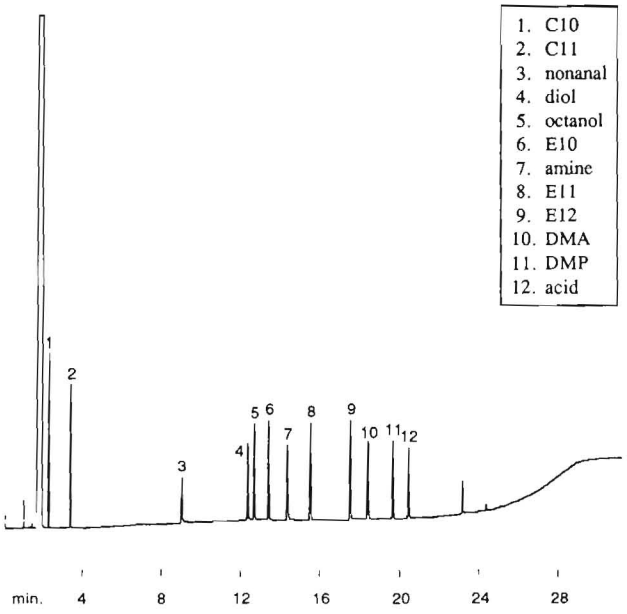


Figure 7 - Complete adsorption of many active compounds occurs when a 5-meter untreated section of stainless steel tubing is connected to the Stabilwax® column

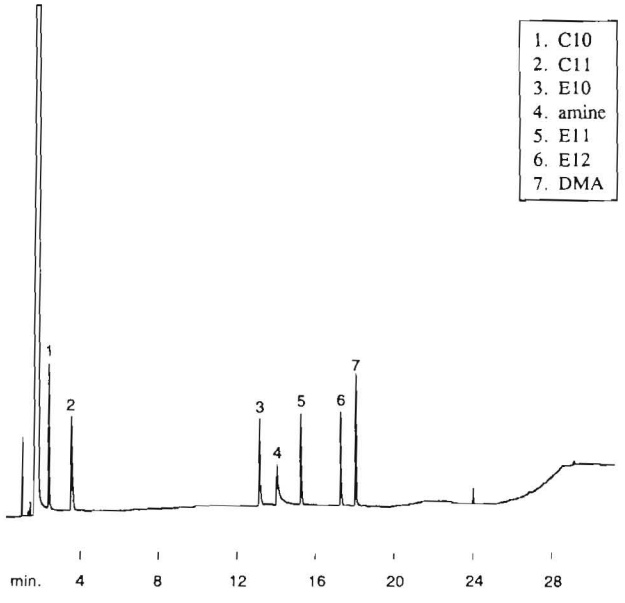
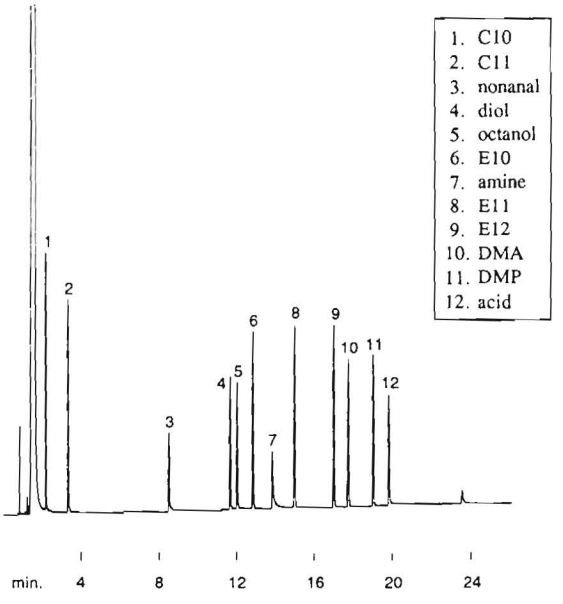


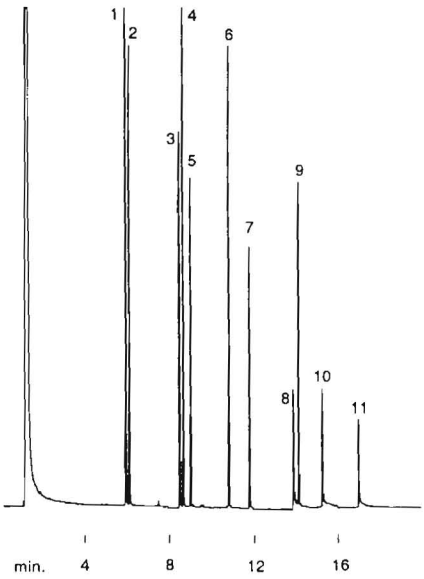
Figure 8 - The inertness of the Stabilwax® column is unchanged when a 5-meter piece of Silcosteel® tubing is attached



Active Environmental Compounds Are Excellent Test Probes to Evaluate Column Inertness

Capillary column inertness can also be illustrated by measuring the response of active environmental compounds at low concentration levels. The primary analytical column used in environmental labs is the 5% diphenyl/95% dimethyl polysiloxane (XTI®-5). To examine the inertness of MXT® columns, Silcosteel® tubing was coated with a high temperature 5% diphenyl polysiloxane stationary phase and tested with several active environmental pollutants such as phenols and pesticides. Figure 9 shows an injection of EPA Method 604 phenols at 25ng/µl on an MXT®-5 column. At this low concentration level, the excellent peak symmetry and response of highly active compounds such as 2,4-dinitrophenol, 4-nitrophenol, and pentachlorophenol (peaks 5, 6, & 8 respectively) indicate a high degree of inertness. Figure 10 shows the analysis of EPA CLP pesticides on an MXT®-5 column. Chlorinated pesticides, such as endrin and DDT, are also good indicators of column inertness since they readily decompose on active surfaces. The excellent response of these reactive compounds and the low ECD bleed illustrates the utility of the MXT® columns for analyzing active environmental pollutants.

Figure 9 - The MXT®-5 column demonstrates excellent inertness with EPA Method 604 phenols.

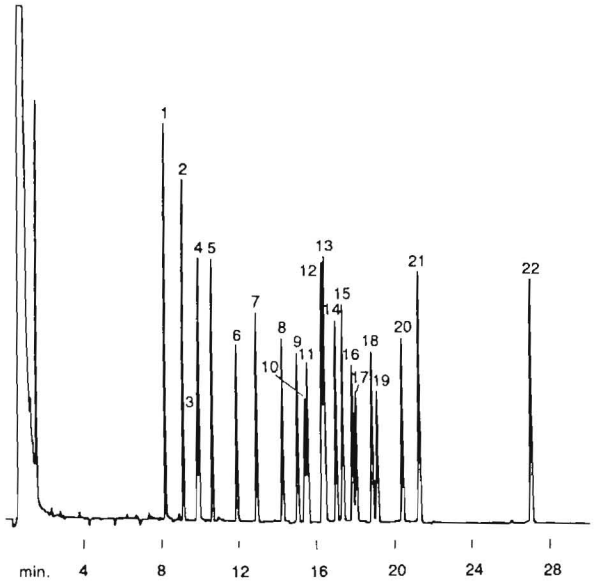


1. phenol
2. 2-chlorophenol
3. 2-nitrophenol
4. 2,4-dimethylphenol
5. 2,4-dichlorophenol
6. 4-chloro-3-methylphenol
7. 2,4,6-trichlorophenol
8. 2,4-dinitrophenol
9. 4-nitrophenol
10. 2-methyl-4,6-dinitrophenol
11. pentachlorophenol

30m, 0.28mm ID, 0.25µm MXT®-5 (cat.# 70224)
1.0µl splitless injection of EPA Method 604 phenols. Concentration 25ng/µl.

Oven temp.: 40°C to 250°C @ 10°C/min.
Inj./det. temp.: 280°C/300°C
Carrier gas: hydrogen
Linear velocity: 50cm/sec. set @ 40°C
FID sensitivity: 2.56 x 10^{-10} AFS
Splitless hold time: 1.5 min.

Figure 10 - The MXT®-5 shows low bleed and excellent inertness of CLP pesticides when used with an ECD.



1. 2,4,5,6-tetrachloro-m-xylene (IS)
2. α-BHC
3. β-BHC
4. γ-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide
9. γ-chlordane
10. endosulfan I
11. α-chlordane
12. dieldrin
13. p,p'-DDE
14. endrin
15. endosulfan II
16. p,p'-DDD
17. endrin aldehyde
18. endosulfan sulfate
19. p,p'-DDT
20. endrin ketone
21. methoxychlor
22. decachlorobiphenyl (IS)

Pesticide Mix A & B (cat.#'s 32003 & 32004)

30m, 0.53mm ID, 0.50µm MXT®-5 (cat.# 70240)
1.0µl splitless injection of pesticides. Concentration 1.0ng/µl.

Oven temp.: 40°C to 150°C @ 20°C/min., then to 275°C @ 5°C/min.
Inj./det. temp.: 240°C/300°C
Carrier gas: helium
Linear velocity: 74cm/sec. set @ 40°C
ECD sensitivity: 33 kHz full scale
Splitless hold time: 0.50 min.

Thermal Stability

MXT® Columns Have Excellent Thermal Stability

Capillary gas chromatography with fused silica columns is restricted to 360°C because of the limited thermal stability of the polyimide coating. At temperatures above 360°C, the polyimide coating becomes very brittle, leading to spontaneous breakage and short column lifetimes. However, the superior thermal stability of stainless steel MXT® columns makes them ideal for high temperature analyses.

An example of such analysis is high temperature simulated distillation (SIM DIST). SIM DIST analyses have always been a problem with standard fused silica capillary columns since a high oven temperature (430°C) is required to elute sample components. At this high temperature, fused silica columns become brittle due to thermal shock. MXT® columns, specifically made for high temperature SIM DIST, are ideal because they can withstand being temperature programmed to 430°C repeatedly as shown in Figure 11.

Another example of high temperature analysis is high molecular weight polynuclear aromatic hydrocarbons (PAHs). Successful quantitation of PAHs requires high oven temperatures to elute the components, maintain good peak symmetry, and minimize high molecular weight discrimination. While our XTI®-5 fused silica column can withstand 360°C, an MXT®-5 can be repeatedly programmed to 360°C without any fear of spontaneous breakage or degradation of the exterior fused silica coating. Figure 12 (on page 8) shows the analysis of PAHs on an MXT®-5. Excellent peak symmetry and resolution of the PAH isomers are observed. The high thermal stability (360°) of the MXT®-5 permits the PAH isomers to elute during the temperature programming portion of the GC run. On columns with limited thermal stability, the PAHs would elute isothermally and exhibit broad peak shapes, decreased resolution, and longer analysis times.

With tubing temperature stability no longer a constraint of column maximum temperature, the thermal stability of the polymer and deactivation layer becomes the limiting factor. For thick film and polar stationary phases, the maximum operating temperatures for both MXT® and fused silica columns are the same. Restek's research chemists are working on new, higher temperature phases that will extend the operating range for capillary GC.

Figure 11 - High temperature SIM DIST sample analyzed on an unbreakable MXT®-SIM DIST at 430°C demonstrates excellent column thermal stability.

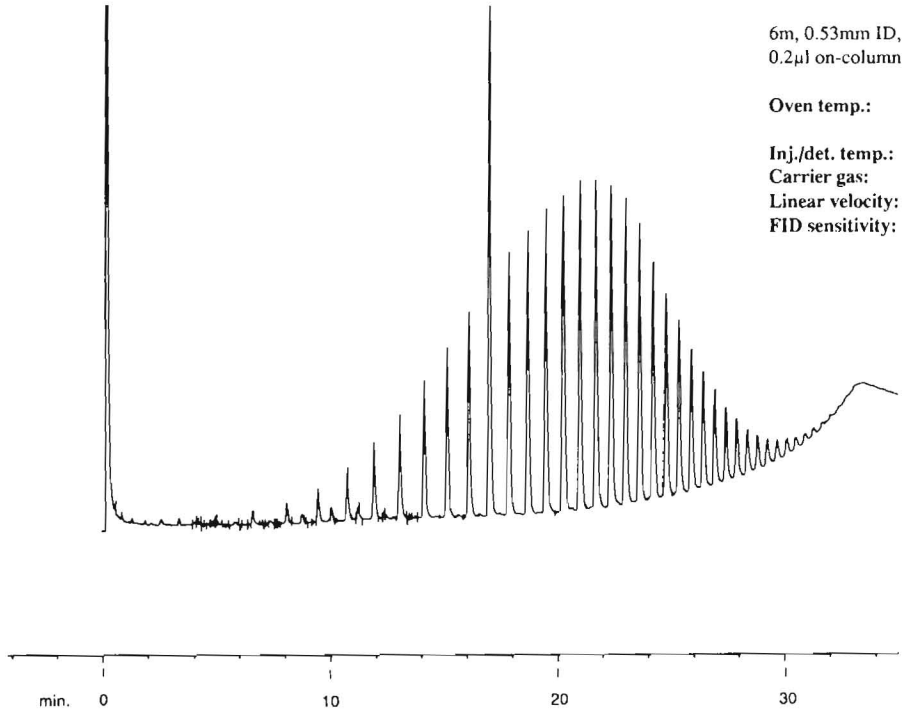
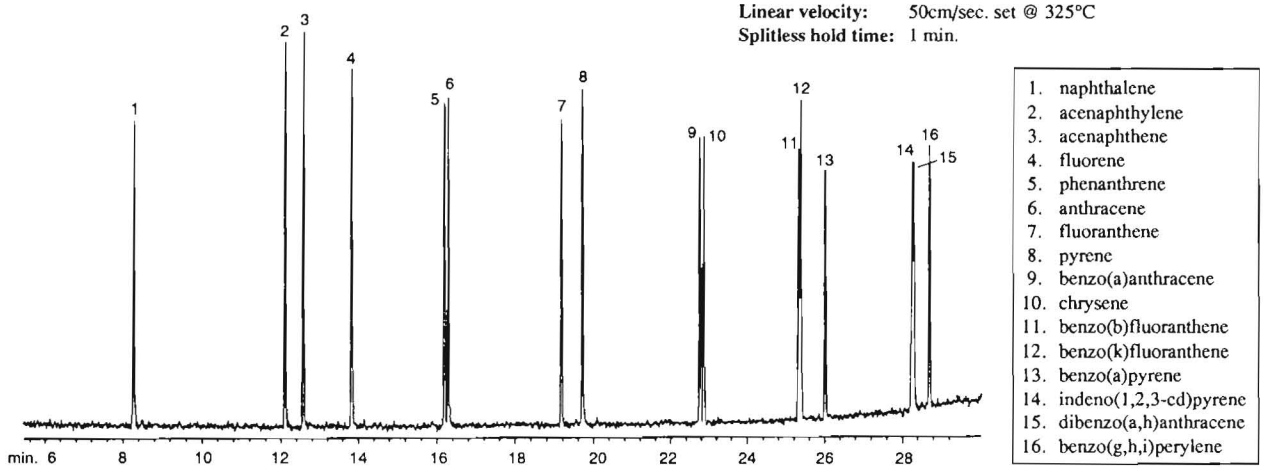


Figure 12 - Achieve excellent separation of polynuclear aromatic hydrocarbons on an MXT®-5.



Strength/Flexibility

MXT® Columns Offer Tubing Flexibility and Strength

Capillary tubing is inherently straight. To install the tubing in a traditional gas chromatograph, it must be wound into a coil. The stress exhibited on the tubing is dependent upon the coil diameter and internal diameter of the tubing. The smaller the column coil diameter, the higher the stress placed on the tubing and the higher the chance of column breakage. Larger internal diameter tubing is also more susceptible to stress fractures.

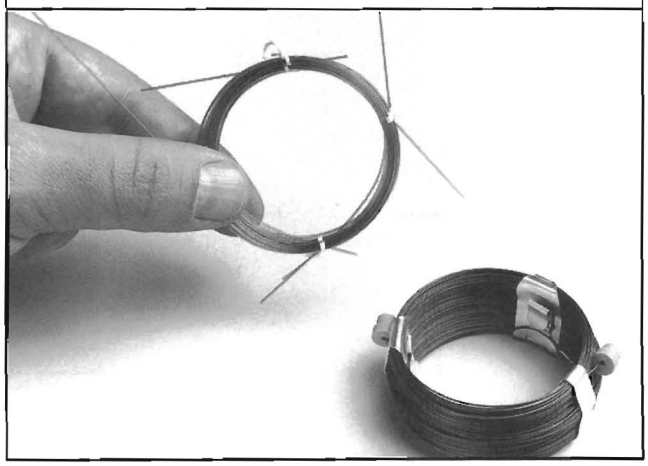
Because stainless steel is very flexible, MXT® columns can be coiled into much smaller diameters (2" minimum) than fused silica columns without risk of breakage. Figure 13 shows a 0.53mm ID fused silica column and an MXT® column coiled into a 2"column diameter. The limited flexibility of fused silica tubing creates stress fractures within the tubing, causing spontaneous breakage. This is eliminated with unbreakable MXT® columns.

Process and portable GC users also benefit from the ruggedness of MXT® columns. These columns can be tightened aggressively without worry of breakage. This alleviates the concern of replacing a broken fused silica column in a potentially dangerous situation. Hydrogen can now be safely used as a carrier gas because the risk of column breakage has been greatly reduced. MXT® columns can also withstand the bumping and jostling encountered when transporting portable GCs to hazardous sites in off-road vehicles. In addition, thin-walled MXT® columns promote a more uniform heat transfer, making them ideal for portable GCs because of their minimized power consumption.

Dependable stainless steel ferrules can be used to ensure a completely leak-free system. This allows process GC chromatographers to use hydrogen as a carrier gas which can double the throughput for an isothermal analysis of a sample stream (compared with using helium).

With inertness and resolution similar to fused silica columns, MXT® capillary columns can generate the same data without risk of down time from a broken column.

Figure 13 - Due to limited flexibility, stress fractures are created within the fused silica tubing, causing spontaneous breakage. Using unbreakable MXT® columns eliminates this.



MXT® Column Installation

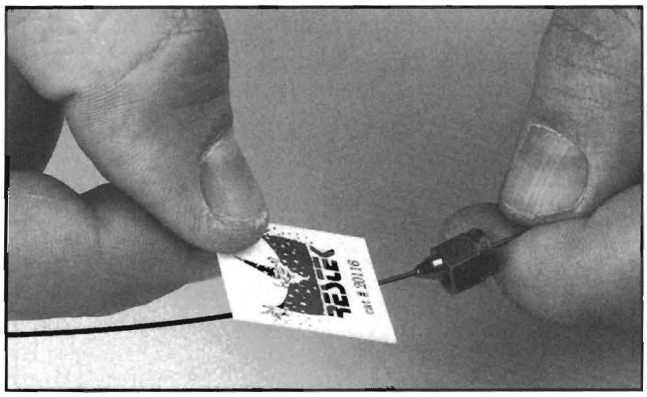
MXT® columns are made with thin-walled (0.004"- 0.005"), stainless steel tubing and are simple to install. Both the 0.28mm and 0.53mm ID columns can be installed using conventional 0.8mm ID graphite ferrules. MXT® columns can be installed directly into most instruments without any modification or pre-column adaptor. For instance, 0.28mm ID columns can be installed directly into a mass spectrometer source, eliminating the need for transfer lines and connectors.

Note: Exert caution when using MXT® columns in gas chromatographs or GC/MS systems with electrically energized detector jets or orifices. MXT® columns, like aluminum clad fused silica, will conduct electricity and cause a short if the end of the column is installed too far into the detector with the detector energized. Always turn off the electrometer with Varian, Perkin-Elmer, and Shimadzu FIDs (since the detector jet is ungrounded) when installing MXT® columns.

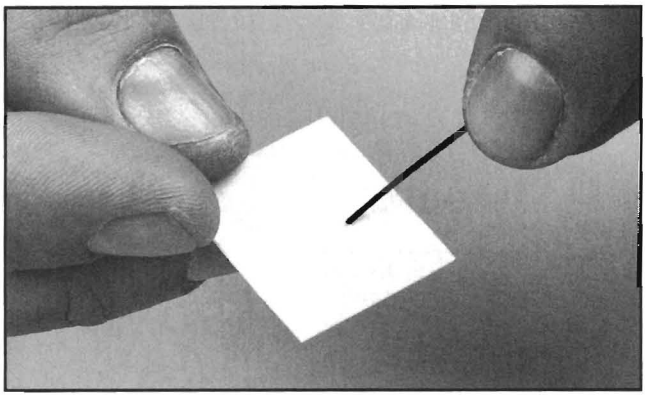
Note: Refer to our Column Installation Guide for more detailed instructions.

Cutting Metal Capillary Tubing

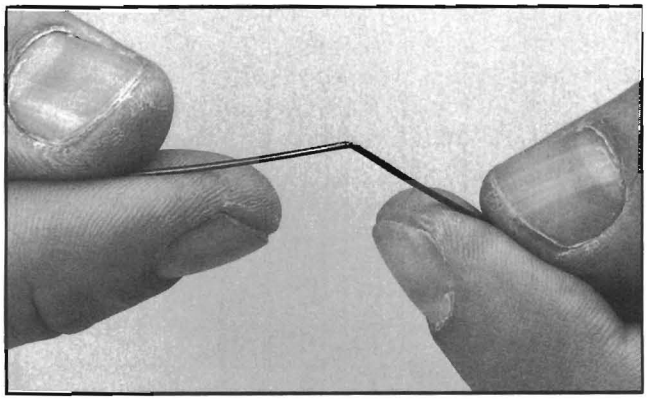
Cut metal capillary tubing by scoring the tubing wall (without cutting completely through) with the edge of a sharp file or ceramic scoring wafer (cat.# 20116). Wipe any filings off of the tubing and bend it away from the score. Once the score opens, bend the tubing in the opposite direction (toward the score) until it snaps into two pieces. The roundness of the tubing should be preserved. If the hole is not round or there is a burr on the tubing, try the procedure again. We do not recommend using high speed wheels or grinders to cut the metal tubing since they may introduce metal filings into the tubing or ruin the polymer near the cut from the high temperatures created.



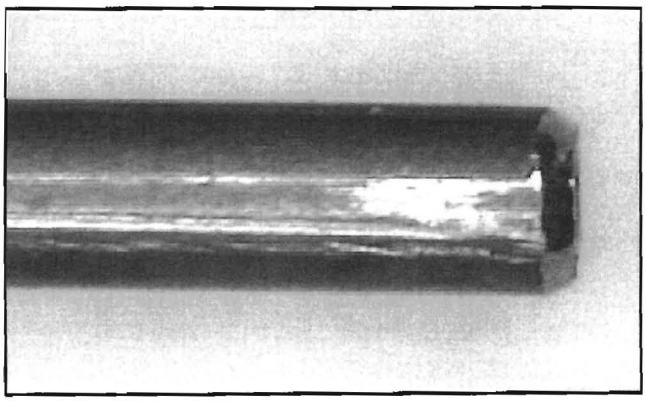
1. Score and wipe away filings.



3. Polish the end with a ceramic wafer and install, using the same procedure as a fused silica column.



2. Bend *away* from score first, then apply force in the opposite direction. Tubing should break cleanly.

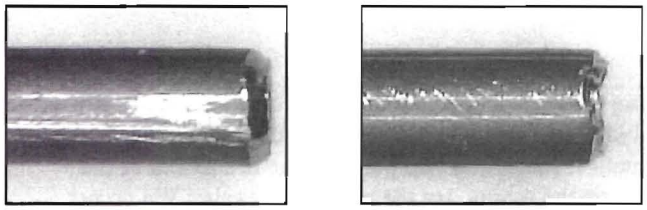


View of properly cut column end.

Can MXT® columns be used with direct injection glass inlet sleeves that utilize Press-Tight® tapers?

MXT® columns work with direct injection sleeves such as a Uniliner® or Vu-Tight®, providing the column end is cut smoothly. The outer surface of the column is irregular when the tubing is initially cut with a file. Burrs must be removed and the column end must be rounded in a conical shape as shown in Figure 14.

Figure 14 - MXT® tubing must be cut squarely and burnished into a radially uniform taper to seal properly with direct injection sleeves.



OK Not OK

The flat side of a ceramic scoring wafer can be used to polish or round the column end into a smooth conical shape that seals with the Press-Tight® taper in the glass inlet sleeve. The column should be purged with gas during the polishing operation to prevent metal fragments from entering the bore.

** Restek's R&D group is working on a ceramic de-burring tool that forms a perfect conical end on MXT® columns. Please call your local distributor for availability of this tool.*

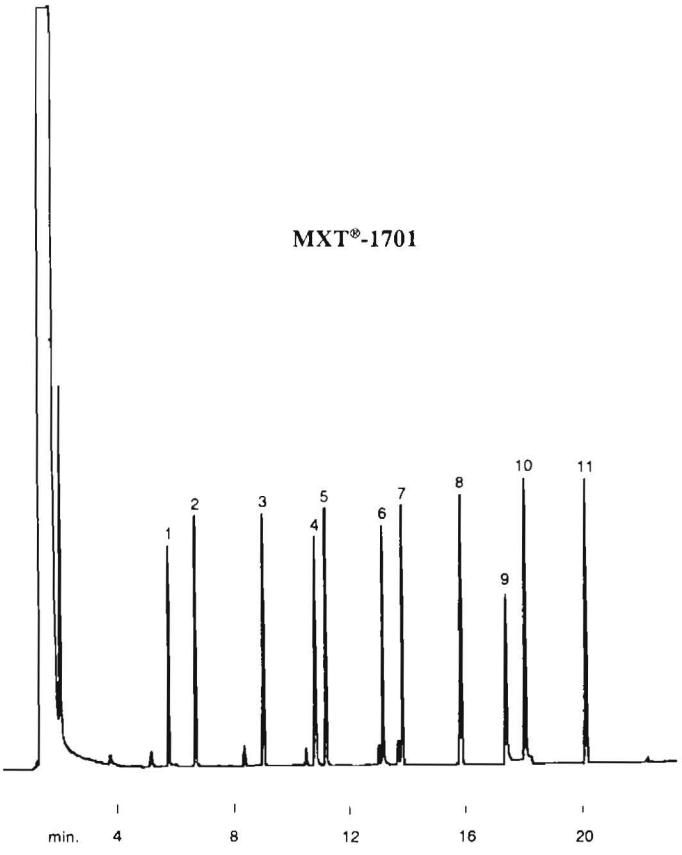
Figure 15 shows a chromatogram of the Grob test mixture obtained with an MXT® column installed in a Vu-Tight® direct injection sleeve. The sharp, solvent peak indicates a leak-free seal made between the MXT® column and Press-Tight® taper of the glass sleeve. The symmetrical peak shapes of the active Grob components, 2,3-butanediol and 1-octanol (peaks 1 and 4 respectively), indicate good column inertness in the direct injection sleeve.

Figure 15 - The sharp solvent peak and symmetrical peak shapes demonstrate the excellent chromatography obtained when connecting an MXT® column to a Vu-Tight® or other direct injection inlet sleeves that utilize a Press-Tight® taper.

1. 2,3-butanediol
2. decane
3. undecane
4. octanol
5. nonanal
6. 2,6-DMP
7. 2,6-DMA
8. methyl decanoate
9. dicyclohexylamine
10. methyl undecanoate
11. methyl dodecanoate

30m, 0.53mm ID, 1.0µm MXT®-1701 (cat.# 72055)
1.0µl direct injection of the Grob test mix.
Concentration 10ng/ per component on-column.

Oven temp.: 40°C to 220°C @ 6°C/min., then 15°C/min. to 280°C (hold 15 min.)
Inj./det. temp.: 250°C/280°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec.
FID sensitivity: 8 x 10^{-11} AFS



MXT® Applications

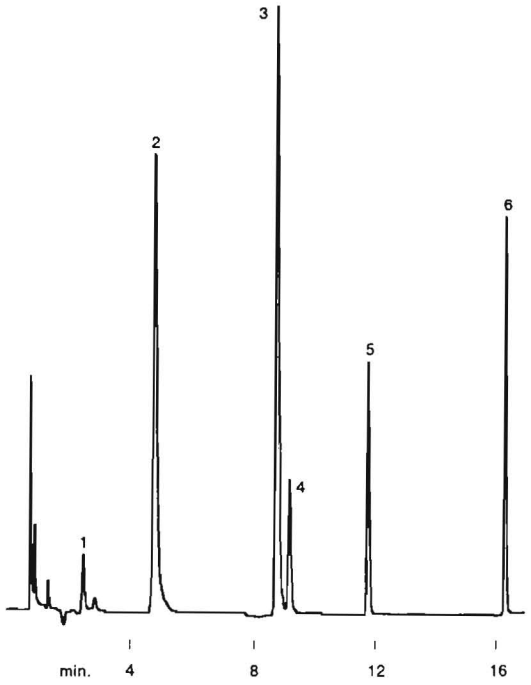
This section features a wide variety of environmental, petrochemical, industrial chemical, and fragrance applications on Restek's MXT® columns.

If you are interested in an application not shown, or need help optimizing your analysis, call your local distributor for assistance.

Applications Index

Volatile Compounds
EPA Method 501 & 504

MXT®-Volatiles (splitless injection)



1. chloroform
2. bromodichloromethane
3. dibromochloromethane
4. 1,2-dibromoethane
5. bromoform
6. 1,2-dibromo-3-chloropropane

501 Trihalomethanes
(cat.# 30036)
504 EDB/DBCP Mix
(cat.# 30034)

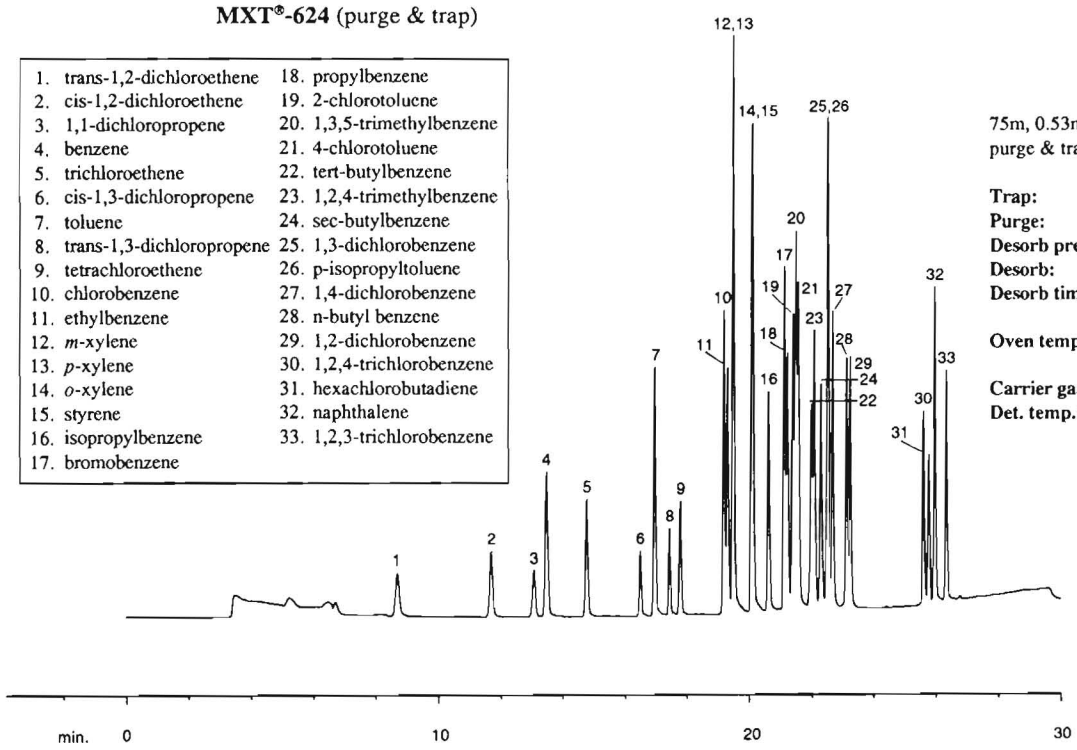
30m, 0.53mm ID, 2.0µm MXT®-Volatiles (cat.# 70925)
1.0µl splitless injection. Concentration 20ng/µl.

Oven temp.:	50°C (hold 6 min.) to 200°C @ 10°C/min.
Inj./det. temp.:	250°C
Carrier gas:	helium
Linear velocity:	20cm/sec. (flow rate: 2.5cc/min.)
ECD sensitivity:	4 kHz full scale

EPA Method 502.2

MXT®-624 (purge & trap)

1. trans-1,2-dichloroethene
2. cis-1,2-dichloroethene
3. 1,1-dichloropropene
4. benzene
5. trichloroethene
6. cis-1,3-dichloropropene
7. toluene
8. trans-1,3-dichloropropene
9. tetrachloroethene
10. chlorobenzene
11. ethylbenzene
12. *m*-xylene
13. *p*-xylene
14. *o*-xylene
15. styrene
16. isopropylbenzene
17. bromobenzene
18. propylbenzene
19. 2-chlorotoluene
20. 1,3,5-trimethylbenzene
21. 4-chlorotoluene
22. tert-butylbenzene
23. 1,2,4-trimethylbenzene
24. sec-butylbenzene
25. 1,3-dichlorobenzene
26. p-isopropyltoluene
27. 1,4-dichlorobenzene
28. n-butyl benzene
29. 1,2-dichlorobenzene
30. 1,2,4-trichlorobenzene
31. hexachlorobutadiene
32. naphthalene
33. 1,2,3-trichlorobenzene



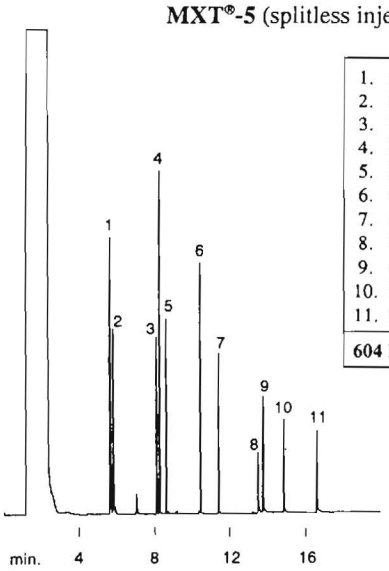
75m, 0.53mm ID, 3.0µm MXT®-624 (cat.# 70974)
purge & trap LSC-2000

Trap:	Tenax, silica gel, charcoal
Purge:	11 min. @ 40ml/min.
Desorb preheat:	220°C
Desorb:	225°C
Desorb time:	2 min. @ 10mls/min.
Oven temp.:	35°C (hold 8 min.) @ 10°C/min. to 220°C (hold 3 min.)
Carrier gas:	helium: 10mls/min.
Det. temp.:	PID @ 250°C

Semi-Volatile Compounds

EPA Method 604 Phenols

MXT®-5 (splitless injection)



1. phenol
2. 2-chlorophenol
3. 2-nitrophenol
4. 2,4-dimethylphenol
5. 2,4-dichlorophenol
6. 4-chloro-3-methylphenol
7. 2,4,6-trichlorophenol
8. 2,4-dinitrophenol
9. 4-nitrophenol
10. 2-methyl-4,6-dinitrophenol
11. pentachlorophenol

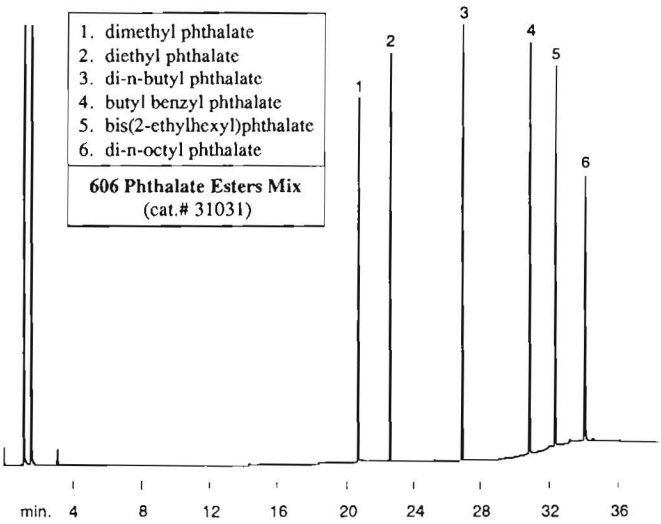
604 Phenols Mix (cat.# 31029)

30m, 0.28mm ID, 0.25µm MXT®-5 (cat.# 70224)
1.0µl splitless injection of phenols. Concentration 25ng/µl per component.

Oven temp.:	40°C to 250°C @ 10°C/min.	**Linear velocity:**	50cm/sec. set @ 40°C
Inj./det. temp.:	280°C/300°C		
Carrier gas:	hydrogen	**FID sensitivity:**	2.56 x 10^{-10} AFS

EPA Method 606 Phthlate Esters

MXT®-5 (split injection)



1. dimethyl phthalate
2. diethyl phthalate
3. di-n-butyl phthalate
4. butyl benzyl phthalate
5. bis(2-ethylhexyl)phthalate
6. di-n-octyl phthalate

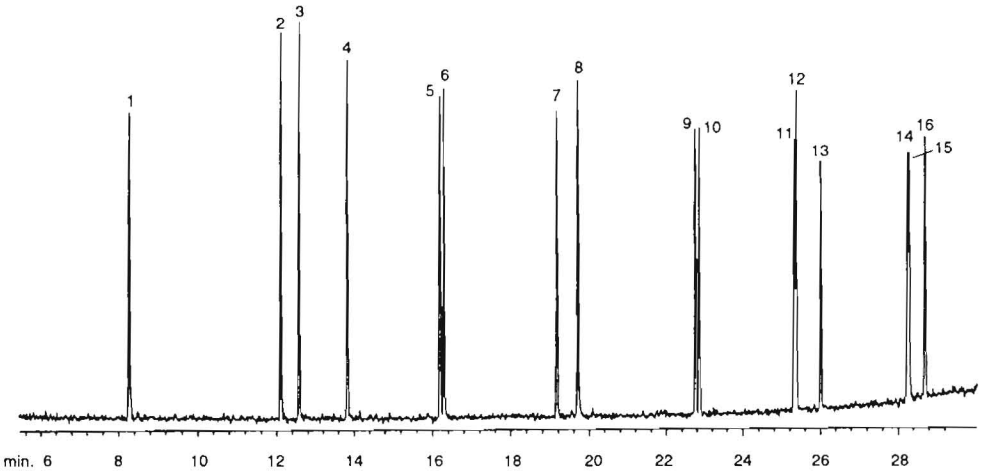
606 Phthalate Esters Mix (cat.# 31031)

30m, 0.53mm ID, 1.0µm MXT®-5 (cat.# 70255)
0.5µl split injection of phthalate esters. Concentration 50ng per component.

Oven temp.:	40°C (hold 6 min.) to 300°C @ 10°C/min. (hold 15 min.)	**Linear velocity:**	50cm/sec.
		Split ratio:	50:1
Inj./det. temp.:	300°C	**FID sensitivity:**	8 x 10^{-11} AFS
Carrier gas:	hydrogen		

EPA Method 610 PNAs

MXT®-5 (splitless injection)



1. naphthalene
2. acenaphthylene
3. acenaphthene
4. fluorene
5. phenanthrene
6. anthracene
7. fluoranthene
8. pyrene
9. benzo(a)anthracene
10. chrysene
11. benzo(b)fluoranthene
12. benzo(k)fluoranthene
13. benzo(a)pyrene
14. indeno(1,2,3-cd)pyrene
15. dibenzo(a,h)anthracene
16. benzo(g,h,i)perylene

SV Calibration Mix #5 (cat.# 31011)

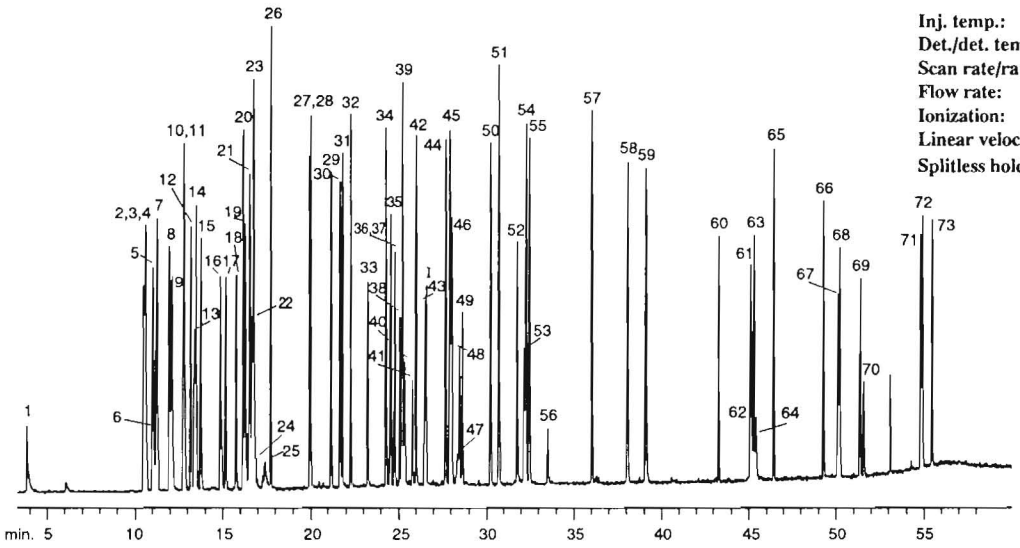
30m, 0.28mm ID, 0.25µm MXT®-5 (cat.# 70224)
1.0µl splitless injection of PNAs. Concentration 20ng/µl.

Oven temp.:	40°C to 325°C @ 10°C/min. (hold 10 min.)	**Carrier gas:**	helium
Inj./det. temp.:	280°C/325°C	**Linear velocity:**	50cm/sec. set @ 325°C
Detector:	MS	**Splitless hold time:**	1 min.

Acid & Base Neutral Priority Pollutants

MXT®-5 (splitless injection by GC/MS)

Permission to publish this chromatogram granted by Paul Macek, Versar Inc.



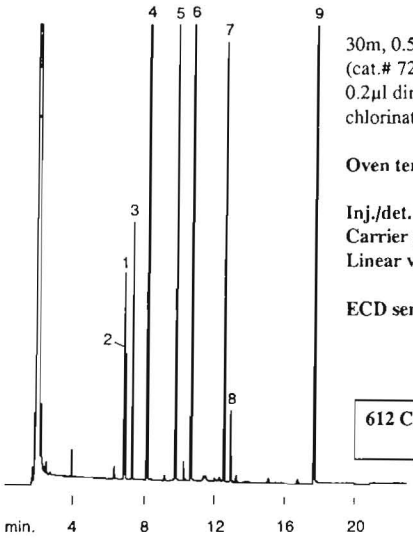
30m, 0.28mm ID, 0.25µm MXT®-5 (cat.# 70224)
1.0µl splitless injection of acids and base neutrals.
Concentration 80ng/µl.

Oven temp.:	35°C (hold 2 min.) to 275°C @ 5°C/min. to 325°C @ 10°C/min. (hold 5 min.)
Inj. temp.:	280°C
Det./det. temp.:	MSD/325°C
Scan rate/range:	0.9 sec./scan / 15-650 AMU
Flow rate:	40 **MS interface:** 305°C
Ionization:	EI **Electron energy:** 70v
Linear velocity:	80cm/sec. set @ 40°C
Splitless hold time:	1 min.

1. N-nitrosodimethylamine
2. phenol
3. 2-chlorophenol
4. bis(2-chloroethyl)ether
5. 1,3-dichlorobenzene
6. 1,4-dichlorobenzene-d4 (IS)
7. 1,4-dichlorobenzene
8. 1,2-dichlorobenzene
9. benzyl alcohol
10. 2-methylphenol
11. 2,2-oxybis-(1-chloropropane)
12. hexachloroethane
13. N-nitroso-di-n-propylamine
14. 4-methylphenol
15. nitrobenzene
16. isophorone
17. 2-nitrophenol
18. 2,4-dimethylphenol
19. bis(2-chloroethoxy)methane
20. 2,4-dichlorophenol
21. 1,2,4-trichlorobenzene
22. naphthalene-d8 (IS)
23. naphthalene
24. benzoic acid
25. 4-chloroaniline
26. hexachloro-1,3-butadiene
27. 4-chloro-3-methylphenol
28. 2-methylnaphthalene
29. hexachlorocyclopentadiene
30. 2,4,5-trichlorophenol
31. 2,4,6-trichlorophenol
32. 2-chloronaphthalene
33. 2-nitroaniline
34. acenaphthylene
35. dimethyl phthalate
36. 2,6-dinitrotoluene
37. 2,4-dinitrotoluene
38. acenaphthene-d10 (IS)
39. acenaphthene
40. 3-nitroaniline
41. 2,4-dinitrophenol
42. dibenzofuran
43. 4-nitrophenol
44. fluorene
45. 4-chlorophenyl phenyl ether
46. diethyl phthalate
47. 4-nitroaniline
48. 4,6-dinitro-2-methylphenol
49. N-nitrosodiphenylamine
50. 4-bromophenyl phenyl ether
51. hexachlorobenzene
52. pentachlorophenol
53. phenanthrene-d10 (IS)
54. phenanthrene
55. anthracene
56. carbazole
57. di-n-butyl phthalate
58. fluoranthene
59. pyrene
60. butyl benzyl phthalate
61. benzo(a)anthracene
62. chrysene-d12 (IS)
63. chrysene
64. 3,3-dichlorobenzidine
65. bis(2-ethylhexyl)phthalate
66. di-n-octyl phthalate
67. benzo(b)fluoranthene
68. benzo(k)fluoranthene
69. benzo(a)fluoranthene
70. perylene-d12 (IS)
71. indeno(1,2,3-cd)pyrene
72. dibenzo(a,h)anthracene
73. benzo(g,h,i))perylene
I. 2,4-dinitrobenzene acetic acid (impurity)

EPA Method 612 Chlorinated Hydrocarbons

MXT®-5 (direct injection)



30m, 0.53mm ID, 0.50µm MXT®-5
(cat.# 72040)
0.2µl direct injection of
chlorinated hydrocarbons.

Oven temp.:	40°C to 280°C @ 8°C/ min. (hold 15 min.)
Inj./det. temp.:	200°C/300°C
Carrier gas:	helium
Linear velocity:	20cm/sec. (flow rate: 2.5cc/min.)
ECD sensitivity:	2.56 kHz full scale

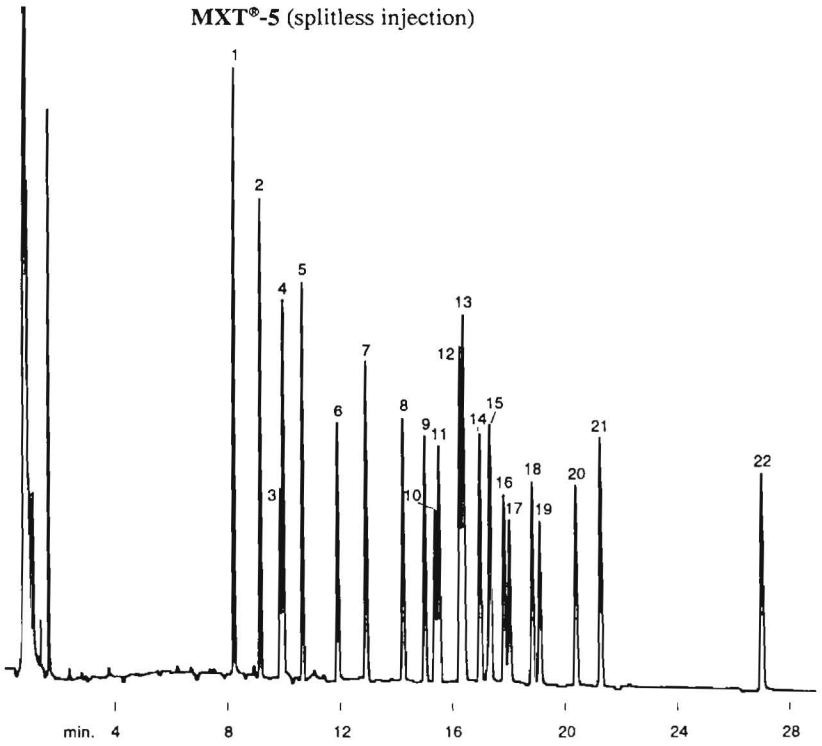
612 Chlorinated Hydrocarbons Mix
(cat.# 31035)

1. 1,3-dichlorobenzene (0.2mg/ml)
2. 1,4-dichlorobenzene (0.3mg/ml)
3. 1,2-dichlorobenzene (0.3mg/ml)
4. hexachloroethane (0.02mg/ml)
5. 1,2,4-trichlorobenzene (0.2mg/ml)
6. hexachlorobutadiene (0.02mg/ml)
7. hexachlorocyclopentadiene (0.02mg/ml)
8. 2-chloronaphthalene (0.3mg/ml)
9. hexachlorobenzene (0.02mg/ml)

Pesticides

EPA Method 608

MXT®-5 (splitless injection)



30m, 0.53mm ID, 0.50µm MXT®-5 (cat.# 70240)
1.0µl splitless injection of pesticides.
Concentration 1.0ng/µl.

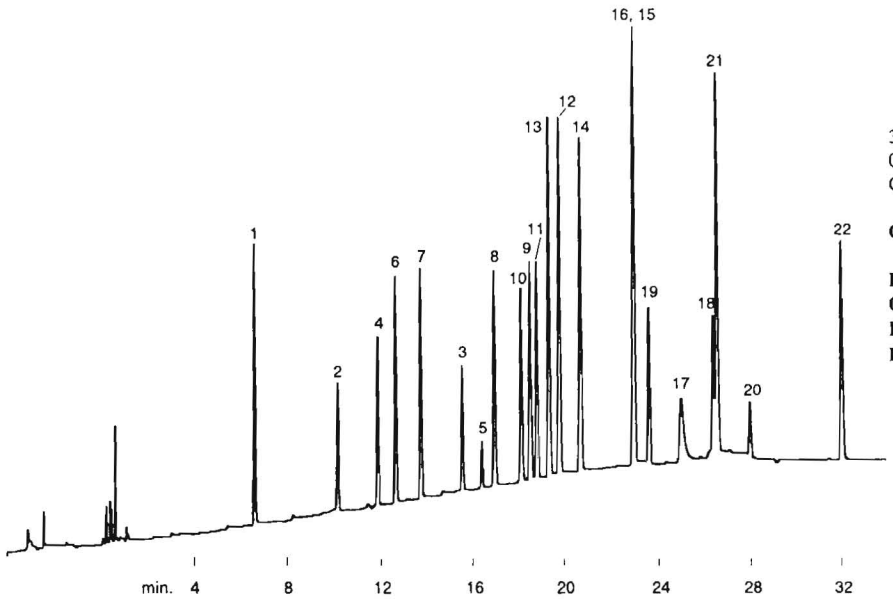
Oven temp.: 40°C to 150°C @ 20°C/min., then to 275°C @ 5°C/min.
Det./det. temp.: 240°C/300°C
Carrier gas: helium
Linear velocity: 74cm/sec. @ 40°C
ECD sensitivity: 33 kHz full scale

1. 2,4,5,6-tetrachloro-m-xylene (IS)
2. α-BHC
3. β-BHC
4. γ-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide
9. γ-chlordane
10. endosulfan I
11. α-chlordane
12. dieldrin
13. p,p'-DDE
14. endrin
15. endosulfan II
16. p,p'-DDD
17. endrin aldehyde
18. endosulfan sulfate
19. p,p'-DDT
20. endrin ketone
21. methoxychlor
22. decachlorobiphenyl (IS)

Pesticide Mix A & B
(cat.#'s 32003 & 32004)

EPA Method 608

MXT®-1701 (splitless injection)



30m, 0.53mm ID, 0.50µm MXT®-1701 (cat.# 72040)
0.2µl splitless injection of chlorinated pesticides.
Concentration 1.0ng/µl per component.

Oven temp.: 40°C (hold 5 min.) to 150°C @ 25°C/min., then to 275°C @ 4°C/min. (hold 5 min.)
Det./det. temp.: 240°C/275°C
Carrier gas: helium
Linear velocity: 54cm/sec.
ECD sensitivity: 2.56 kHz full scale

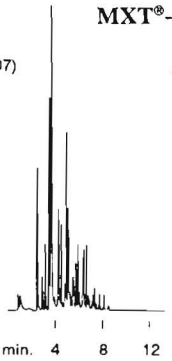
Aroclor® Quick Screening

MXT®-5 (splitless injection)

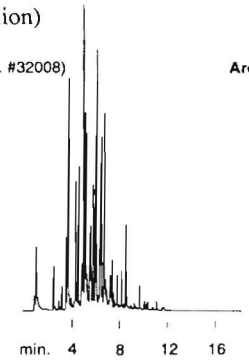
30m, 0.53mm ID, 0.50µm MXT®-5 (cat.# 70240)
2.0µl splitless injection of Aroclors.
Concentration 50ppm.

Oven temp.: 150°C to 300°C @ 12°C/min. (hold 5 min.)
Inj./det. temp.: 250°C/300°C
Carrier gas: helium
Linear velocity: 30cm/sec.
ECD sensitivity: 16 Hz full scale

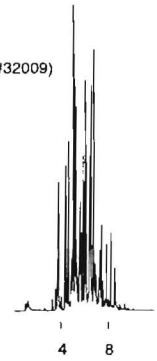
Aroclor® 1221 Mix (cat. #32007)



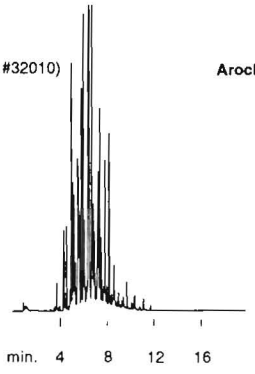
Aroclor® 1232 Mix (cat. #32008)



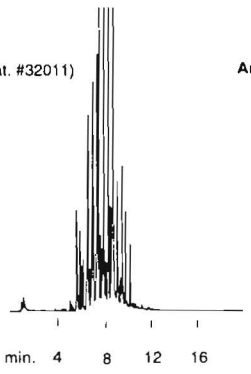
Aroclor® 1242 Mix (cat. #32009)



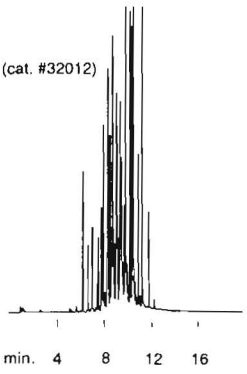
Aroclor® 1248 Mix (cat. #32010)



Aroclor® 1254 Mix (cat. #32011)



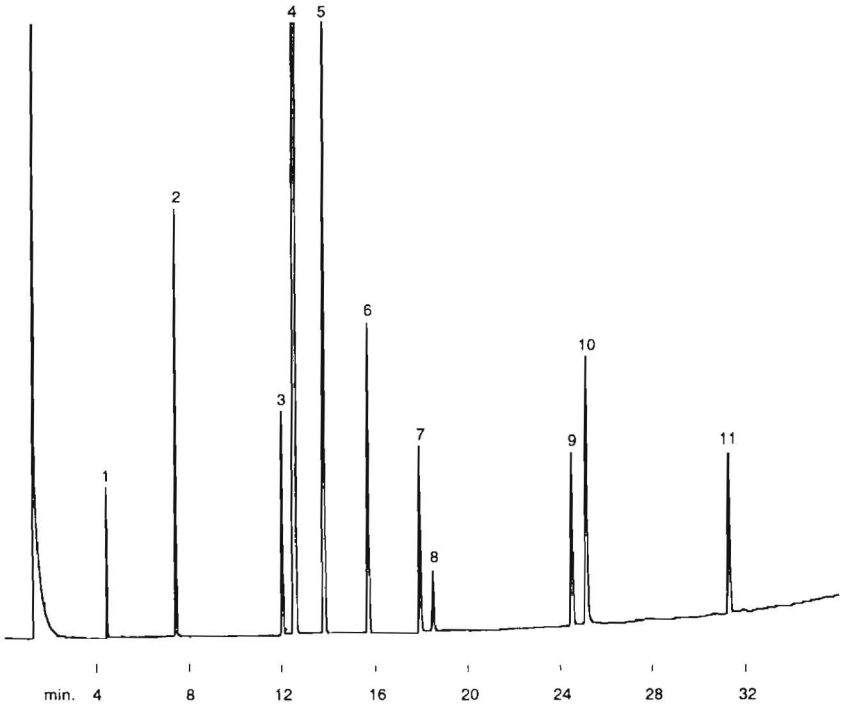
Aroclor® 1260 Mix (cat. #32012)



Food & Flavor Samples

Canola Oil

MXT®-WAX (split injection)



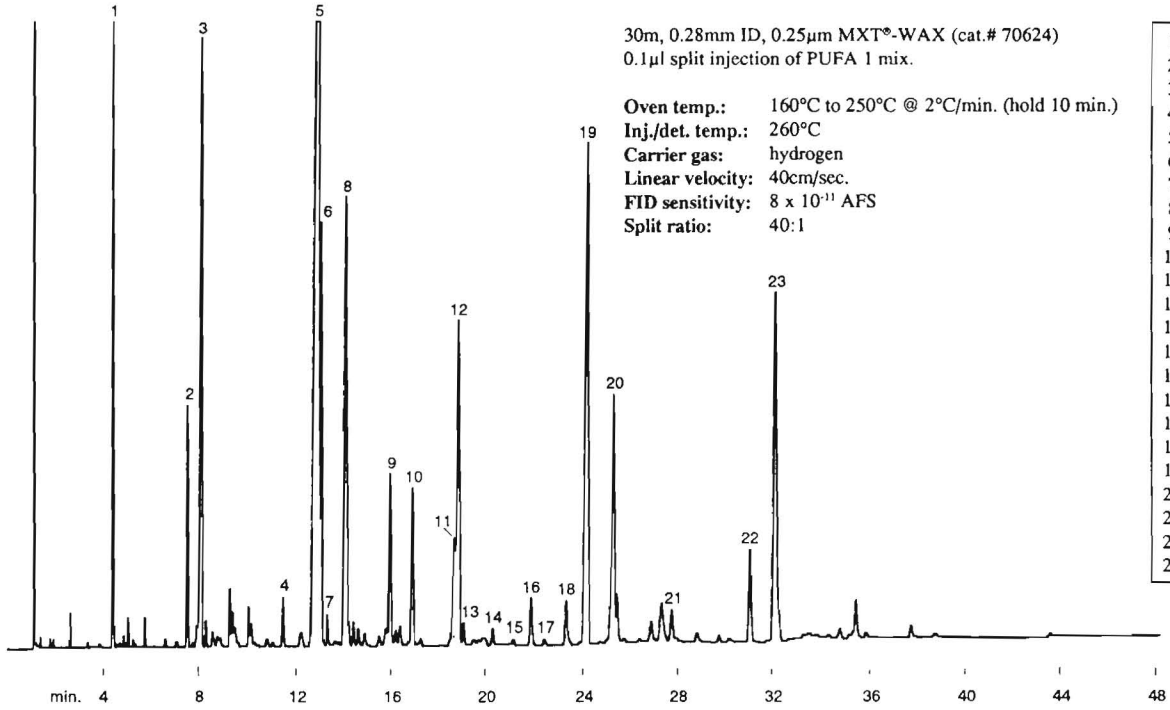
1. C14:0
2. C16:0
3. C18:0
4. C18:1
5. C18:2
6. C18:3
7. C20:0
8. C20:1
9. C22:0
10. C22:1
11. C24:0

30m, 0.28mm ID, 0.25µm MXT®-WAX (cat.# 70624)
1.0µl split injection of canola oil.
Concentration 25mg/ml per component.

Oven temp.: 160°C to 250°C @ 2°C/min.
Inj./det. temp.: 260°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec.
FID sensitivity: 3.2×10^{-11} AFS
Split ratio: 80:1

PUFA (Marine Source)

MXT®-WAX (split injection)



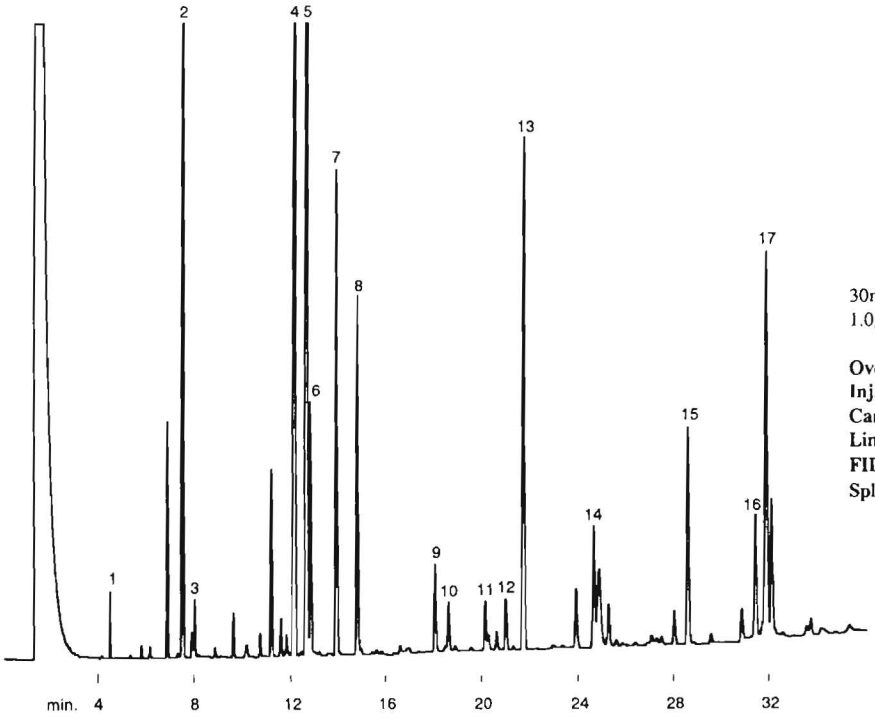
30m, 0.28mm ID, 0.25µm MXT®-WAX (cat.# 70624)
0.1µl split injection of PUFA 1 mix.

Oven temp.:	160°C to 250°C @ 2°C/min. (hold 10 min.)
Inj./det. temp.:	260°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	8 x 10^{-11} AFS
Split ratio:	40:1

1. C14:0
2. C16:0
3. C16:1ω7
4. C16:4ω1
5. C18:1ω9
6. C18:1ω7
7. C18:1ω5
8. C18:2ω6
9. C18:3ω3
10. C18:4ω3
11. C20:1ω11
12. C20:1ω9
13. C20:1ω7
14. C20:2ω6
15. C20:3ω6
16. C20:4ω6
17. C20:3ω3
18. C20:4ω3
19. C22:1ω11
20. C22:1ω9
21. C21:5ω3
22. C22:5ω3
23. C22:6ω3

PUFA (Animal Source)

MXT®-WAX (split injection)



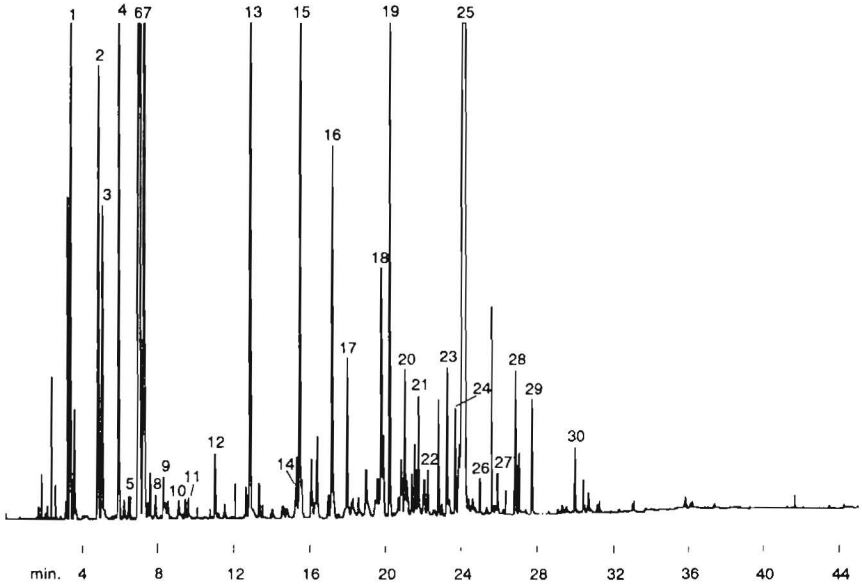
1.	C14:0	10.	C20:1ω9
2.	C16:0	11.	C20:2ω6
3.	C16:1ω7	12.	C20:3ω6
4.	C18:0	13.	C20:4ω6
5.	C18:1ω9	14.	C20:5ω3
6.	C18:1ω7	15.	C22:4ω6
7.	C18:2ω6	16.	C22:5ω3
8.	C18:3ω3	17.	C22:6ω3
9.	C20:1ω11		

30m, 0.28mm ID, 0.25µm MXT®-WAX (cat.# 70624)
1.0µl split injection of PUFA 2 mix.

Oven temp.:	160°C to 250°C @ 2°C/min. (hold 10 min.)
Inj./det. temp.:	260°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	8 x 10^{-11} AFS
Split ratio:	20:1

Spearmint Oil

MXT®-WAX (split injection)



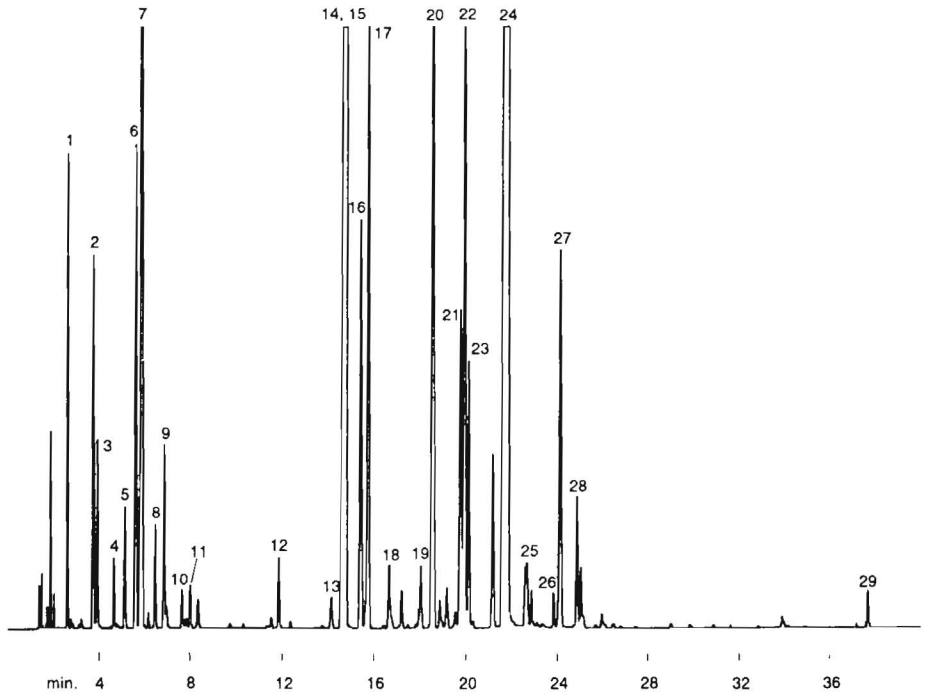
1.	α-pinene	16.	δ-bourbonene
2.	β-pinene	17.	linalool
3.	sabinene	18.	terpinene-4-ol
4.	myrcene	19.	β-caryophyllene
5.	α-terpinene	20.	dihydrocarvone
6.	L-limonene	21.	trans-dihydrocarvyl acetate
7.	1,8-cineole	22.	trans-β-farnesene
8.	cis-ocimene	23.	α-terpineol
9.	γ-terpinene	24.	germacrene-D
10.	*p*-cymene	25.	carvone
11.	terpinolene	26.	cis-carvyl acetate
12.	3-octyl acetate	27.	trans-carveol
13.	3-octanol	28.	cis-carveol
14.	L-menthone	29.	cis-jasmone
15.	trans-sabinenehydrate	30.	viridiflorol

30m, 0.28mm ID, 0.50µm MXT®-WAX (cat.# 70639)
0.2µl split injection of neat spearmint oil.

Oven temp.:	75°C to 200°C @ 4°C/min. (hold 10 min.)
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec. set @ 75°C
FID sensitivity:	4 x 10^{-11} AFS
Split ratio:	40:1

Peppermint Oil

MXT®-WAX (split injection)



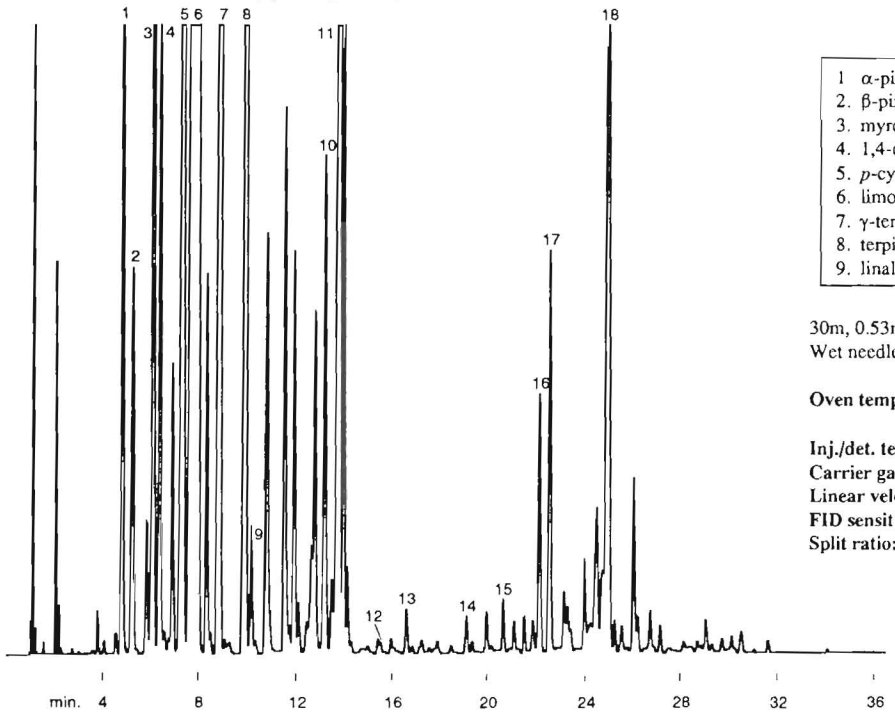
1.	α-pinene	16.	menthofuran
2.	β-pinene	17.	d-isomenthone
3.	sabinene	18.	β-bourbonene
4.	myrcene	19.	linalool
5.	α-terpinene	20.	menthyl acetate
6.	L-limonene	21.	neo-menthol
7.	1,8-cineole	22.	β-caryophyllene
8.	cis-ocimene	23.	terpinene-4-ol
9.	γ-terpinene	24.	L-menthol
10.	*p*-cymene	25.	pulegone
11.	terpinolene	26.	α-terpineol
12.	3-octanol	27.	germacrene-D
13.	3-octen-3-ol	28.	piperitone
14.	L-menthone	29.	viridiflorol
15.	trans-sabinenehydrate		

30m, 0.28mm ID, 0.5µm MXT®-WAX (cat.# 70639)
0.1µl split injection of peppermint oil.

Oven temp.:	75°C (hold 4 min.) to 240°C @ 4°C/min.
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec. @ 75°C
FID sensitivity:	16 x 10^{-11} AFS
Split ratio:	50:1

Lime Oil

MXT®-5 (split injection)



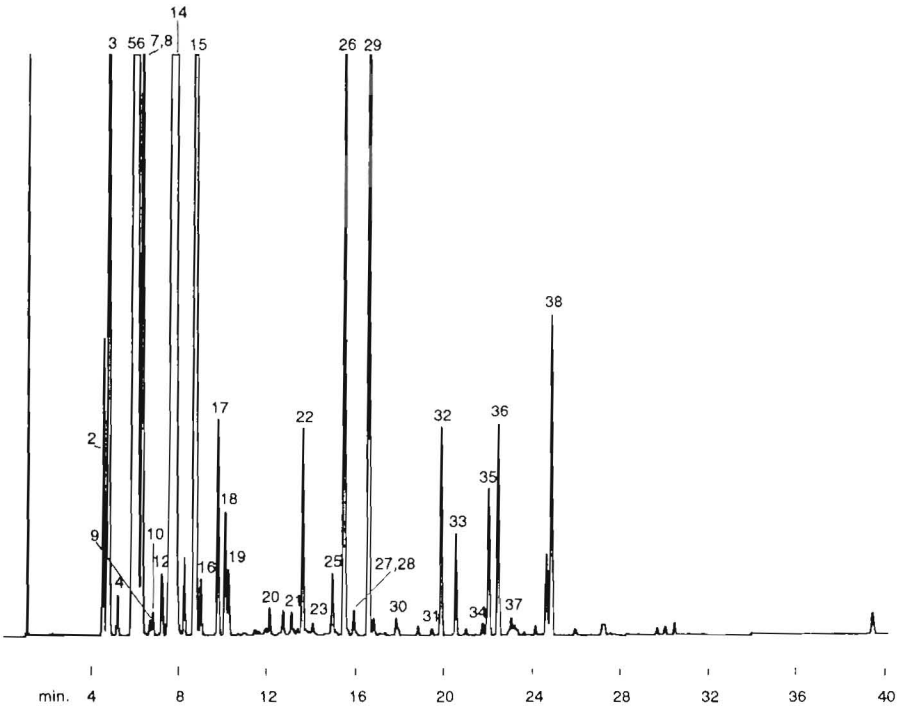
1. α-pinene	10. terpinen-4-ol
2. β-pinene	11. α-terpineol
3. myrcene	12. neral
4. 1,4-cineol & terpinene	13. geranial
5. *p*-cymene	14. neryl acetate
6. limonene	15. geranyl acetate
7. γ-terpenine	16. caryophyllene
8. terpinolene	17. trans-α-bergamotene
9. linalool	18. β-bisabolene

30m, 0.53mm ID, 1.0µm MXT®-5 (cat.# 70255)
Wet needle split injection of neat lime oil.

Oven temp.: 75°C (hold 4 min.) to 200°C @ 4°C/min. (hold 10 min.)
Inj./det. temp.: 250°C
Carrier gas: hydrogen
Linear velocity: 45cm/sec.
FID sensitivity: 32 x 10^{-11} AFS
Split ratio: 50:1

Lemon Oil

MXT®-5 (split injection)



1. heptanol	20. citronellal
2. α-thujene	21. terpinen-4-ol
3. α-pinene	22. α-terpineol
4. camphene	23. decanol
5. sabinene	24. octyl acetate
6. β-pinene	25. nerol
7 6-methyl-5-hepten-2-one	26. neral
8. myrcene	27. carvone
9. octanal	28. geraniol
10. α-phellandrene	29. geranial
11. 3-carene	30. nonyl acetate
12. α-terpinene	31 citronellyl acetate
13. *p*-cymene	32. neryl acetate
14. limonene	33. geranyl acetate
15. γ-terpinene	34. dodecanal
16. octanol	35. β-caryophyllene
17. terpinolene	36. trans-α-bergamotene
18. linalool	37. α-humulene
19. nonanal	38. β-bisabolene

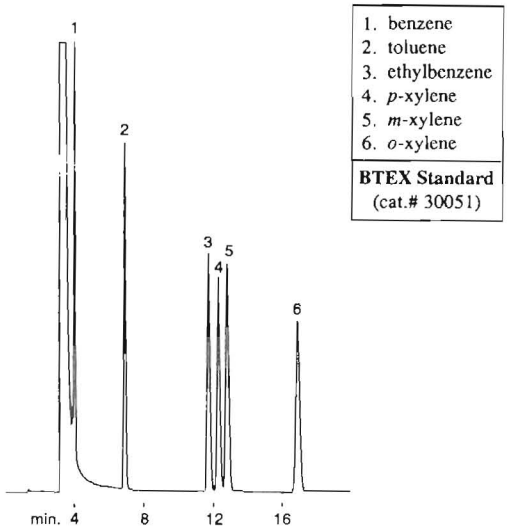
30m, 0.53mm ID, 1.0µm MXT®-5 (cat.# 70255)
Wet needle split injection of lemon oil.

Oven temp.: 75°C (hold 4 min.) to 200°C @ 10°C/min. (hold 10 min.)
Inj./det. temp.: 250°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec.
FID sensitivity: 16 x 10^{-11} AFS
Split ratio: 50:1

Petrochemical Samples

Benzene/Toluene/Xylene

MXT®-WAX (split injection)

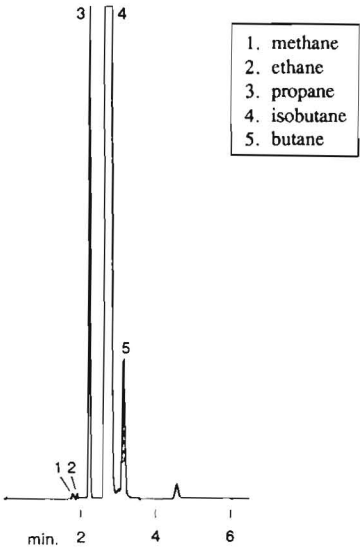


30m, 0.28mm ID, 1.0µm MXT®-WAX (cat.# 70654)
1.0µl split injection of a benzene, toluene, xylene standard.

Oven temp.:	60°C isothermal	**Linear velocity:**	38cm/sec.
Inj./det. temp.:	260°C	**FID sensitivity:**	3.2 x 10^{-11} AFS
Carrier gas:	hydrogen	**Split ratio:**	100:1

Butane

MXT®-1 (direct injection)

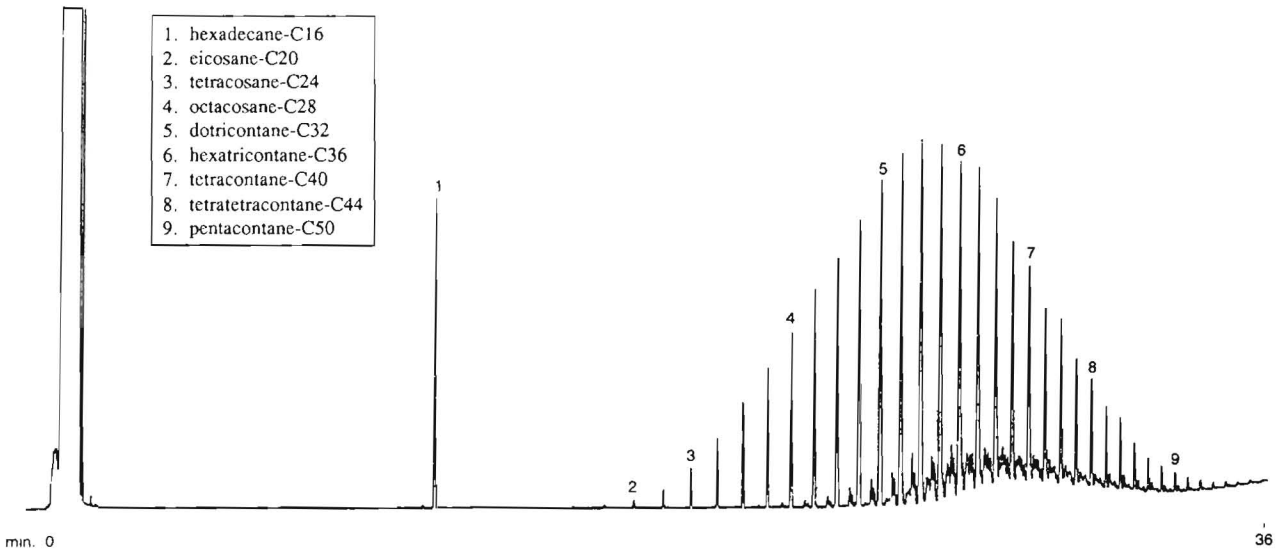


60m, 0.53mm ID, 5.0µm MXT®-1 (cat.# 70183)
1.0µl direct injection of neat butane.

Oven temp.:	40°C isothermal	**Linear velocity:**	40cm/sec.
Inj./det. temp.:	200°C	**FID sensitivity:**	4 x 10^{-11} AFS
Carrier gas:	helium		

Petroleum Wax

MXT®-1 (cool on-column injection)

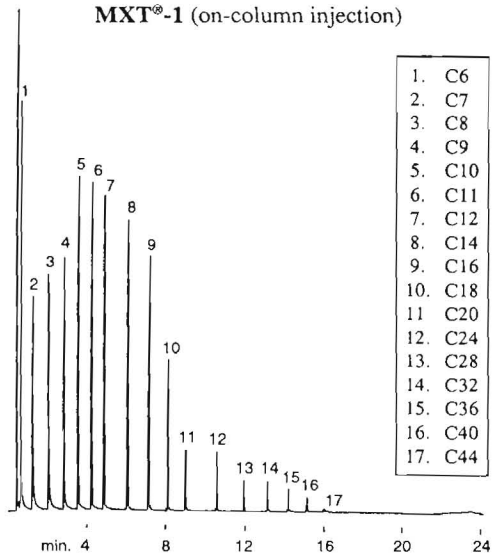


30m, 0.28mm ID, 0.25µm MXT®-1 (cat.# 70124)
1.0µl cool on-column injection of a petroleum wax sample. Concentration 0.1% w/w in cyclohexane.

Oven temp.:	50°C to 400°C @ 10°C/min. (hold 10 min.)	**Linear velocity:**	60cm/sec. set @ 50°C
Inj./det. temp.:	400°C	**FID sensitivity:**	64 x 10^{-11} AFS
Carrier gas:	hydrogen		

High Temperature SIM DIST

MXT®-1 (on-column injection)

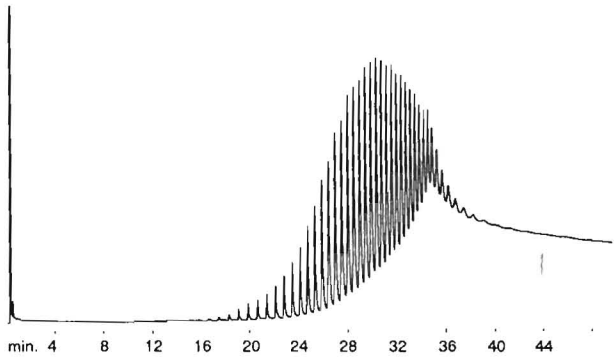


6m, 0.53mm ID, 0.15µm MXT®-1 (cat.# 70101)
Wet needle on-column injection of ASTM D2887 standard.

Oven temp.: -12°C to 430°C @ 20°C/min.
Inj./det. temp.: -17°C to 433°C/430°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec.
FID sensitivity: 128 x 10^{-11} AFS

Polywax 1000

MXT®-1 (on-column injection)

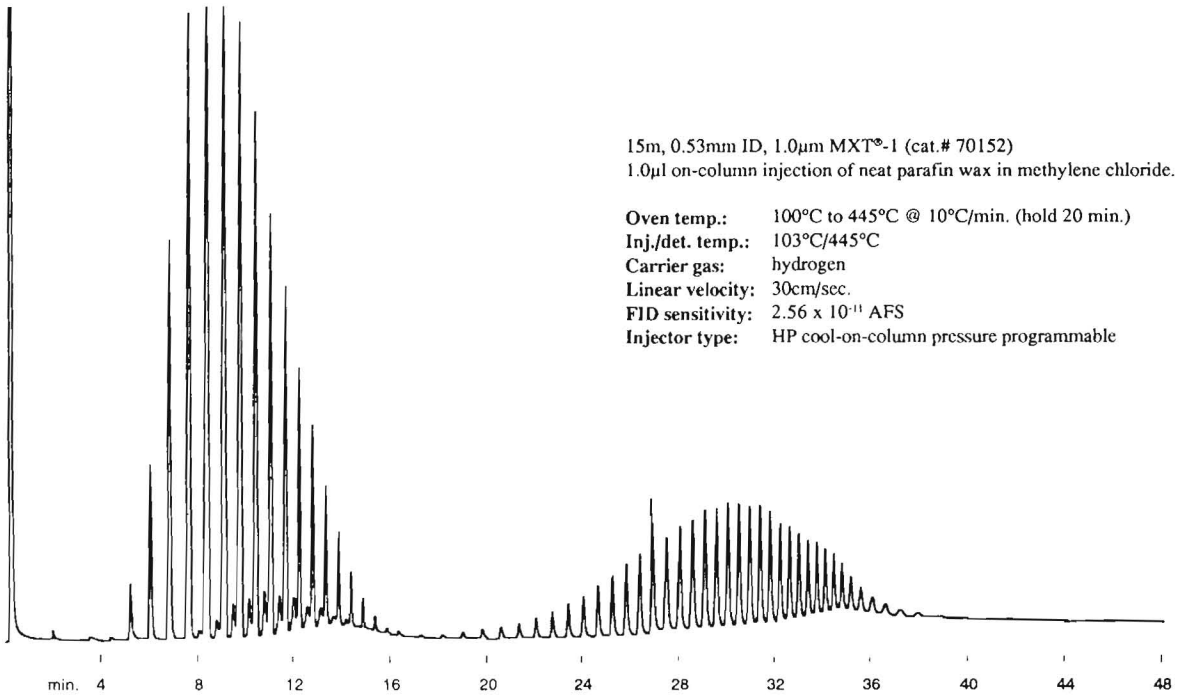


6m, 0.53mm ID, 0.15µm MXT®-1 (cat.# 70101)
0.50µl on-column injection. 6mg/ml polyethylene standard in CS_2.

Oven temp.: 100°C to 430°C @ 10°C/min. (hold 5 min.)
Inj./det. temp.: -103°C to 433°C/430°C
Carrier gas: hydrogen
Linear velocity: 43.3cm/sec.
FID sensitivity: 2.56 x 10^{-10} AFS

Parafins

MXT®-1 (cool-on-column injection)

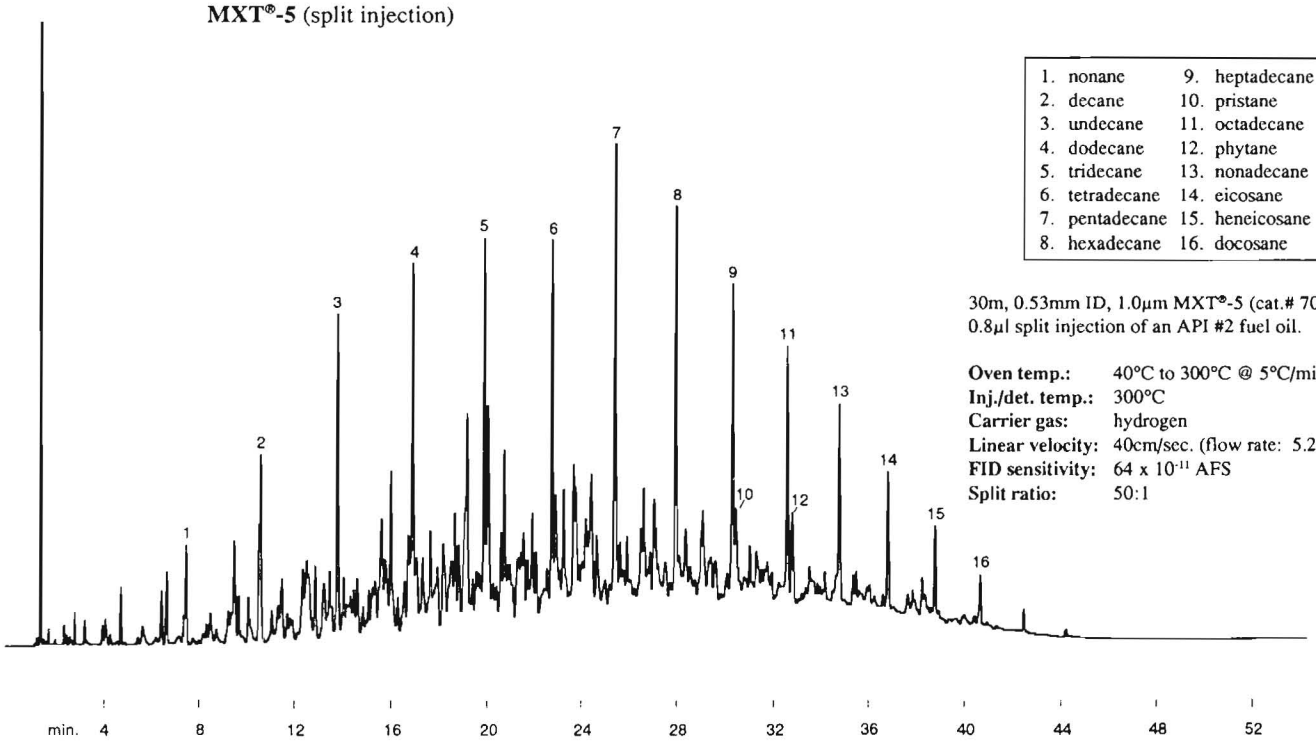


15m, 0.53mm ID, 1.0µm MXT®-1 (cat.# 70152)
1.0µl on-column injection of neat parafin wax in methylene chloride.

Oven temp.: 100°C to 445°C @ 10°C/min. (hold 20 min.)
Inj./det. temp.: 103°C/445°C
Carrier gas: hydrogen
Linear velocity: 30cm/sec.
FID sensitivity: 2.56 x 10^{-11} AFS
Injector type: HP cool-on-column pressure programmable

API #2 Fuel Oil (High Aromatics)

MXT®-5 (split injection)

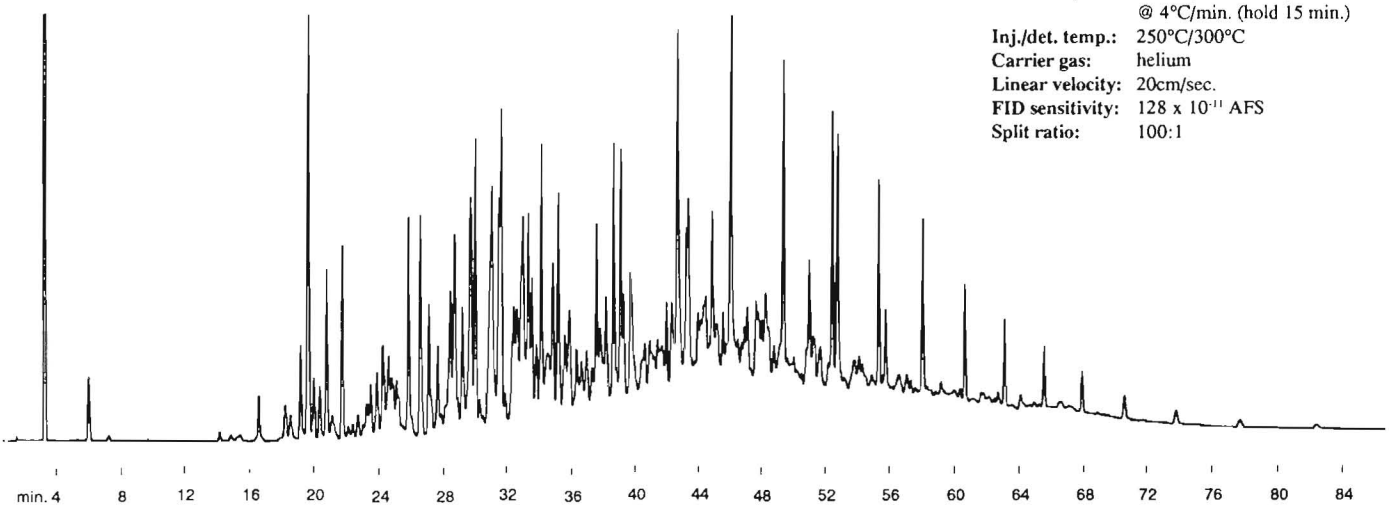


30m, 0.53mm ID, 1.0µm MXT®-5 (cat.# 70179)
0.8µl split injection of an API #2 fuel oil.

Oven temp.:	40°C to 300°C @ 5°C/min.
Inj./det. temp.:	300°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec. (flow rate: 5.2cc/min.)
FID sensitivity:	64 x 10^{-11} AFS
Split ratio:	50:1

Base Fuel & Additive

MXT®-1 (split injection)

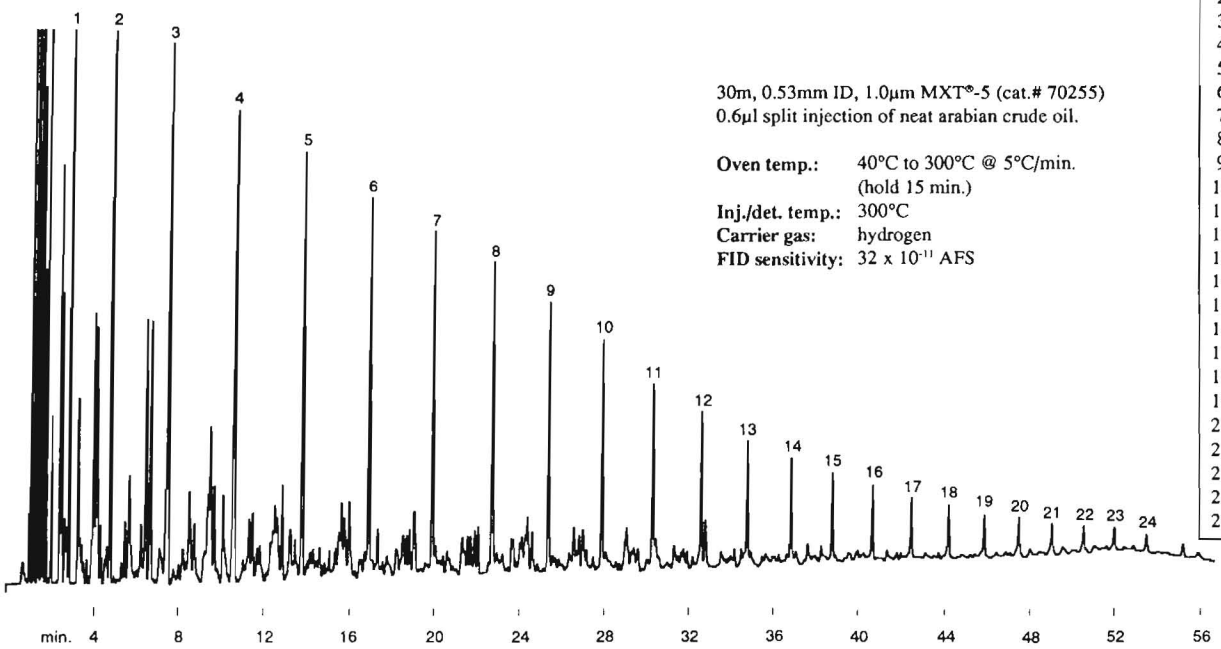


30m, 0.53mm ID, 5.0µm MXT®-1 (cat.# 70179)
0.1µl split injection of base fuel sample.

Oven temp.:	35°C (hold 5 min.) to 270°C @ 4°C/min. (hold 15 min.)
Inj./det. temp.:	250°C/300°C
Carrier gas:	helium
Linear velocity:	20cm/sec.
FID sensitivity:	128 x 10^{-11} AFS
Split ratio:	100:1

Arabian Light Crude Oil

MXT®-5 (split injection)



30m, 0.53mm ID, 1.0µm MXT®-5 (cat.# 70255)
0.6µl split injection of neat arabian crude oil.

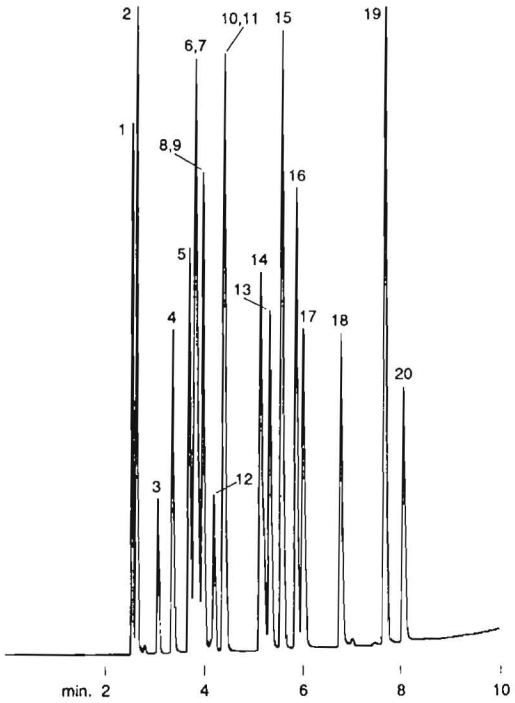
Oven temp.: 40°C to 300°C @ 5°C/min. (hold 15 min.)
Inj./det. temp.: 300°C
Carrier gas: hydrogen
FID sensitivity: 32 x 10^{-11} AFS

1. heptane
2. octane
3. nonane
4. decane
5. undecane
6. dodecane
7. tridecane
8. tetradecane
9. pentadecane
10. hexadecane
11. heptadecane
12. octadecane
13. nonadecane
14. eicosane
15. hencicosane
16. docosane
17. tricosane
18. tetracosane
19. pentacosane
20. hexacosane
21. heptacosane
22. octacosane
23. nonacosane
24. triacontane

Solvent & Chemical Samples

Industrial Solvents Mixture

MXT®-WAX (wet needle injection)



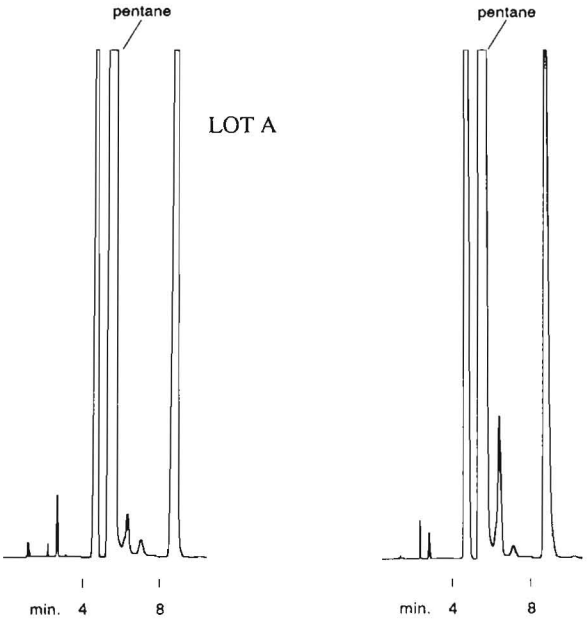
30m, 0.53mm ID, 1.0µm MXT®-WAX (cat.# 70655)
Wet needle injection of neat solvents.

Oven temp.: 50°C to 220°C @ 10°C/min.
Inj./det. temp.: 250°C
Carrier gas: helium
Linear velocity: 20cm/sec.
FID sensitivity: 5.12 x 10^{-10} AFS

1. pentane
2. hexane
3. methyl formate
4. acetone
5. tetrahydrofuran
6. 1,1,1-trichloroethane
7. ethyl acetate
8. methanol
9. methylethyl ketone
10. methylene chloride
11. chloroform
12. benzene
13. n-propyl alcohol
14. sec-butyl alcohol
15. toluene
16. n-butyl acetate
17. isobutyl alcohol
18. n-butyl alcohol
19. *o*-xylene
20. ethoxyethane

Pentane Purity

MXT®-1 (direct injection)

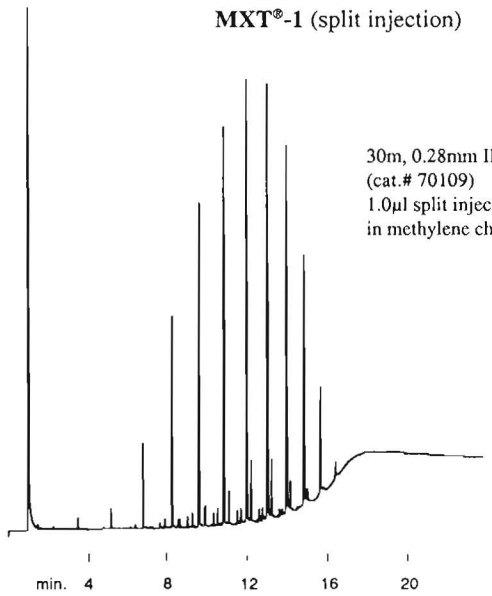


60m, 0.53mm ID, 5.0µm MXT®-1 (cat.# 10183)
1.0µl injection of high purity pentane.

Oven temp.:	40°C isothermal
Inj./det. temp.:	200°C
Carrier gas:	helium
Linear velocity:	40cm/sec. (flow rate: 10cc/min.)
FID sensitivity:	4 x 10^{-11} AFS

Triton X-100™

MXT®-1 (split injection)



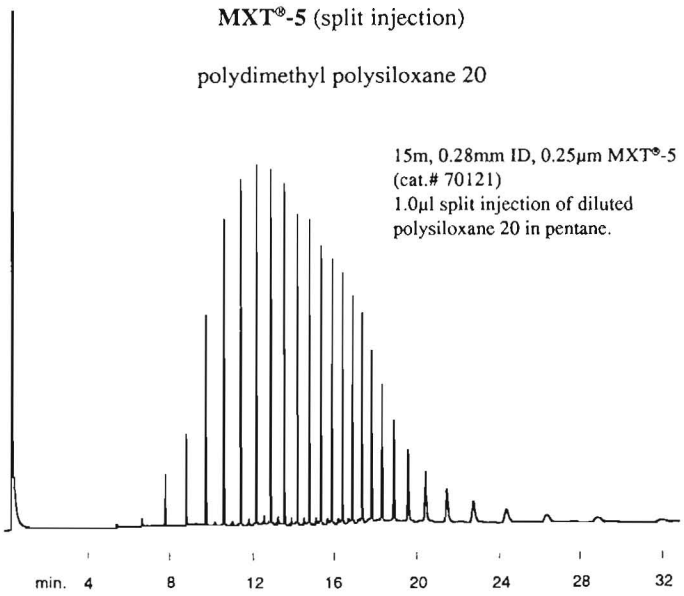
30m, 0.28mm ID, 0.10µm MXT®-1
(cat.# 70109)
1.0µl split injection of Triton X-100™
in methylene chloride.

Oven temp.:	150°C to 400°C @ 15°C/min. (hold 10 min.)	**Linear velocity:**	40cm/sec.
Inj./det. temp.:	250°C/400°C	**FID sensitivity:**	102 x 10^{-11} AFS
Carrier gas:	hydrogen	**Split ratio:**	40:1

Siloxanes

MXT®-5 (split injection)

polydimethyl polysiloxane 20



15m, 0.28mm ID, 0.25µm MXT®-5
(cat.# 70121)
1.0µl split injection of diluted
polysiloxane 20 in pentane.

Oven temp.:	75°C to 340°C @ 15°C/min.	**FID sensitivity:**	16 x 10^{-11} AFS
Inj./det. temp.:	250°C/340°C	**Split ratio:**	100:1
Carrier gas:	hydrogen		
Linear velocity:	40cm/sec.		

MXT® Product Listing & Accessories

Restek offers a large selection of MXT® capillary columns now available in eight different polarities!

* Custom columns are available: call your local distributor if the column you require is not shown here.

MXT®-1

(100% dimethyl polysiloxane)

Applications
SIM DIST, waxes, fuel oils, pharmaceutical & solvents

df (µm)	max.* temp.	0.28mm ID columns 15-meter cat.#	0.28mm ID columns 30-meter cat.#	0.28mm ID columns 60-meter cat.#	0.53mm ID columns 15-meter cat.#	0.53mm ID columns 30-meter cat.#	0.53mm ID columns 60-meter cat.#
0.10	400°C	70106	70109	--------	--------	--------	--------
0.25	360°C	70121	70124	70127	70122	70125	70128
0.50	330°C	70136	70139	70142	70137	70140	70143
1.00	325°C	70151	70154	70157	70152	70155	70158
1.50	320°C	--------	--------	--------	70167	70170	70173
3.00	300°C	70181	70184	70187	70182	70185	70188
5.00	275°C	--------	--------	--------	70177	70179	70183
7.00	250°C	--------	--------	--------	70191	70192	70193

105m, 0.53mm ID, 3.0µm, cat.# 70189

MXT®-5

(95% dimethyl/ 5% diphenyl polysiloxane)

Applications
semi-volatiles, pesticides, PCBs, environmental samples & essential oils

df (µm)	max.* temp.	0.28mm ID columns 15-meter cat.#	0.28mm ID columns 30-meter cat.#	0.28mm ID columns 60-meter cat.#	0.53mm ID columns 15-meter cat.#	0.53mm ID columns 30-meter cat.#	0.53mm ID columns 60-meter cat.#
0.25	360°C	70221	70224	70227	70222	70225	70228
0.50	330°C	70236	70239	70242	70237	70240	70243
1.0	325°C	70251	70254	70257	70252	70255	70258
1.5	320°C	--------	--------	--------	70267	70270	70273
3.0	300°C	70281	70284	70287	70282	70285	70288
5.0	275°C	--------	--------	--------	70277	70279	70283

MXT®-1301

(7% cyanopropyl/ 93% dimethyl polysiloxane)

Applications
volatile organics & pharmaceutical

df (µm)	max.* temp.	0.28mm ID columns 15-meter cat.#	0.28mm ID columns 30-meter cat.#	0.28mm ID columns 60-meter cat.#	0.53mm ID columns 15-meter cat.#	0.53mm ID columns 30-meter cat.#	0.53mm ID columns 60-meter cat.#
0.25	280°C	76021	76024	76027	76022	76025	76028
0.50	270°C	76036	76039	76042	76037	76040	76043
1.0	260°C	76051	76054	76057	76052	76055	76058
1.5	250°C	76066	76069	76072	76067	76070	76073
3.0	240°C	--------	--------	--------	76082	76085	76088

MXT®-20

(80% dimethyl/20% diphenyl polysiloxane)

Applications
flavor aromatics, alcoholic beverages

df (µm)	max.* temp.	0.28mm ID columns 15-meter cat.#	0.28mm ID columns 30-meter cat.#	0.28mm ID columns 60-meter cat.#	0.53mm ID columns 15-meter cat.#	0.53mm ID columns 30-meter cat.#	0.53mm ID columns 60-meter cat.#
0.25	310°C	70321	70324	70327	70322	70325	70328
0.50	300°C	70336	70339	70342	70337	70340	70343
1.0	295°C	70351	70354	70357	70352	70355	70358
1.5	280°C	70366	70369	70372	70367	70370	70373
3.0	260°C	70381	70384	70387	70382	70385	70388

MXT®-1701

(14% cyanopropyl/ 86% dimethyl polysiloxane)

Applications
pesticides, PCBs, pharmaceutical, alcohols and solvents

df (µm)	max.* temp.	0.28mm ID columns 15-meter cat.#	0.28mm ID columns 30-meter cat.#	0.28mm ID columns 60-meter cat.#	0.53mm ID columns 15-meter cat.#	0.53mm ID columns 30-meter cat.#	0.53mm ID columns 60-meter cat.#
0.25	280°C	72021	72024	72027	72022	72025	72028
0.50	270°C	72036	72039	72042	72037	72040	72043
1.0	260°C	72051	72054	72057	72052	72055	72058
1.5	250°C	72066	72069	72072	72067	72070	72073
3.0	240°C	--------	--------	--------	72082	72085	72088

MXT®-Wax

(Crossbond® Carbowax®)

Applications
FAMEs, flavors, BTEX solvents, essential oils, EPA Method 603

df (µm)	max.* temp.	0.28mm ID columns 15-meter cat.#	0.28mm ID columns 30-meter cat.#	0.28mm ID columns 60-meter cat.#	0.53mm ID columns 15-meter cat.#	0.53mm ID columns 30-meter cat.#	0.53mm ID columns 60-meter cat.#
0.25	250°C	70621	70624	70627	70622	70625	70628
0.50	240°C	70636	70639	70642	70637	70640	70643
1.0	230°C	70651	70654	70657	70652	70655	70658
1.5	220°C	--------	--------	--------	70666	70669	70672
2.0	230°C	--------	--------	--------	70667	70670	--------

Special Application Specific Columns

			0.28mm ID columns			0.53mm ID columns		
MXT®-502.2 Applications volatile organics	df (µm)	max.* temp.	30-meter cat.#	60-meter cat.#	105-meter cat.#	30-meter cat.#	60-meter cat.#	105-meter cat.#
	1.6	270°C	70919	70920	70921	--------	--------	--------
	3.0	270°C	--------	--------	--------	70908	70909	70910
MXT®-Volatiles Applications volatile organics, trihalomethanes	df (µm)	max.* temp.	30-meter cat.#	60-meter cat.#	105-meter cat.#	30-meter cat.#	60-meter cat.#	105-meter cat.#
	1.25	275°C	70924	70926	70928	--------	--------	--------
	2.0	275°C	--------	--------	--------	70925	70927	70929
	3.0	250°C	--------	--------	--------	70922	70923	--------
MXT®-624 (Crossbond® 6% cyanopropyl-phenyl, 94% dimethyl polysiloxane) Applications EPA Methods 502.2, 524, 624, 8240 & 8260	df (µm)	max.* temp.				30-meter cat.#	60-meter cat.#	105-meter cat.#
	3.00	240°C				70971	70973	70975
						75m, 0.53mm ID, 3.0µm, cat.# 70974		
SIM DIST MXT®-1	6m, 0.53mm ID, 0.15µm, cat.# 70101*					*cat.# 70101's are tested at 400°C but may be run at 430°C.		
SIM DIST MXT®-2887 ASTM Method 2887	10m, 0.53mm ID, 2.65µm, cat.# 70199**					**cat.# 70199's maximum temperature is 360°C.		

** All maximum operating temperatures are for 30m columns. Maximum temperatures may be slightly lower for longer lengths.*

Note: Custom columns are available upon request.

Choosing Ferrules for MXT® Columns

Either graphite or Vespel®/graphite ferrules can be used with MXT® columns. Graphite ferrules are soft and pliable, allowing a 0.8mm ID size to seal both 0.28 and 0.53mm ID MXT® columns. Our recommended choice of ferrules for MXT® columns are graphite. They are available for standard 1/16" Swagelok-type instrument fittings or in a special compact version for HP 5890 capillary inlets. Easy-to-use graphite ferrules offer thermal stability to 450°C. Vespel®/graphite ferrules are recommended for mass spectrometers or in applications where the seal will be under vacuum. Because Vespel®/graphite is hard, it must closely match the outside diameter of the column or a proper seal will not be made. Use 0.6mm ID Vespel®/graphite ferrules for 0.28mm ID columns and 0.8mm ID Vespel®/graphite ferrules for 0.53mm ID columns. Vespel®/graphite ferrules can be re-used many times and they have a maximum operating temperature of 400°C. Always remember to tighten Vespel®/graphite ferrules after an initial thermal cycle to compensate for shrinkage.

Ferrules for 1/16" Swagelok-type Capillary Fittings					
Ferrule ID	Fits MXT® Column ID	Graphite cat.#		Vespel®/Graphite cat.#	
0.8mm	0.53mm	20202	10-pk.	20213	10-pk.
0.8mm	0.53mm	20224	50-pk.	20230	50-pk.
0.6mm	0.28mm	--------	--------	20232	10-pk.
Compact Graphite Ferrules for HP GCs (for capillary injection ports)					
0.8mm	0.53mm	20252	10-pk.	20253	50-pk.

MXT® Guard Columns & Transfer Lines

Fused Silica Lined, Stainless Steel Guard Columns

- Increase column lifetime
- Allow more injections before sample residue degrades column performance
- Prevent peak splitting during splitless analysis
- Prevent damage from harmful materials
- Five-meter length offers convenience: make the connection once and break off ½-meter sections as contamination occurs
- A copy of the Grob test chromatogram is included to illustrate the actual inertness of the guard column
- Phenyl methyl deactivated surface provides optimum wettability for both polar and non-polar compounds

The life expectancy of an MXT® capillary column is greatly increased by using a 5-meter, deactivated, MXT® guard column. This prevents non-volatile contamination of the analytical column. Since the guard column is uncoated, sample components are allowed to enter the analytical column freely, while non-volatile contaminants are deposited in the guard column. Once contamination degrades performance, short lengths of the guard column can be removed, maintaining the analytical column's original length. When the guard column is totally contaminated, simply replace it with a new one.

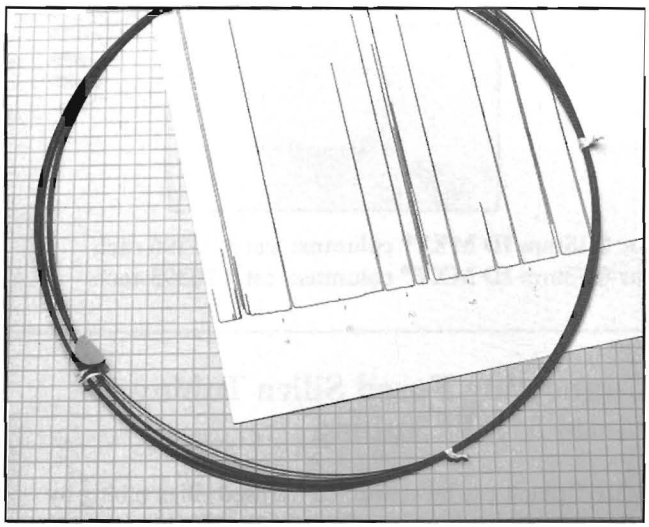
Transfer Lines

- Useful for GC/MS, ITD, MSD, FTIR, purge & trap, headspace analyzers, and other instruments
- Ideal for open split interfaces

Transfer lines provide inert flow paths from a sample introduction device, such as a purge & trap system or a headspace analyzer, to the inlet of an analytical column.

5-meter MXT® Guard Columns/Transfer Lines*:
0.28mm ID: cat.# 70044
0.53mm ID: cat.# 70045

* Longer lengths are available upon request.



Each guard column/transfer line is pretested with the Grob mix to ensure high inertness.

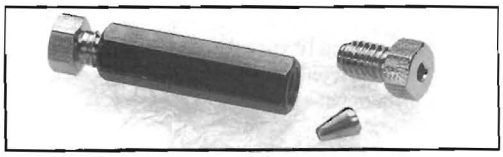
MXT® Low Dead Volume Connectors

In response to customer requests, the Restek wizards have developed metal connectors to connect two MXT® columns together, to attach an MXT® guard column to an analytical column, or to perform confirmational analysis with two MXT® columns.

These low dead volume connectors are treated with Silcosteel® and deactivated to make them inert to active compounds, just like our MXT® columns. They will not cause peak tailing or affect system inertness and can be used up to 400°C without degrading the deactivation layer. We chose a 1/32" Valco-type body size to minimize thermal mass and manufactured special metal ferrules that fit the OD of the 0.28 and 0.53mm ID MXT® columns. Purchase the appropriately sized replacement ferrules when connecting 0.28 and 0.53mm ID columns together with either the MXT® low dead volume or "Y" connector.

MXT® Low Dead Volume Connector:

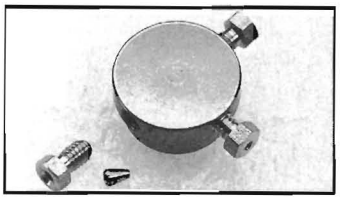
- Connect guard columns/transfer lines to MXT® columns
- Low thermal mass rapidly tracks oven temperature programming



for 0.28mm ID MXT® columns: cat.# 20397 each
for 0.53 mm ID MXT® columns: cat.# 20394 each

MXT® Low Dead Volume "Y" Connector:

- Connect two MXT® columns to one inlet
- Connect one MXT® column to two detectors



for 0.28mm ID MXT® columns: cat.# 20396 each
for 0.53mm ID MXT® columns: cat.# 20395 each

MXT® Connector Replacement Stainless Steel Ferrules			
Ferrule ID	**Fits Column ID**	**cat.#**	
0.59mm	0.28mm	20398	10-pk.
0.79mm	0.53mm	20399	10-pk.
1/32" Valco-type replacement nut: cat.# 20389 $15/5-pk.			

1/4"- 3/16" Open End Wrench

A high quality miniature wrench to use with the MXT® Low Dead Volume Connectors.

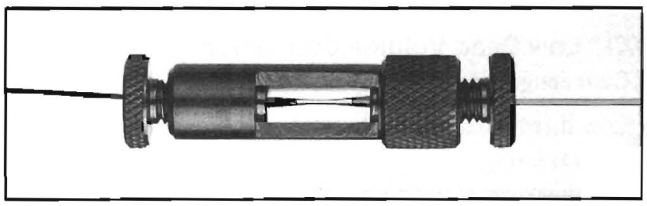
Open End Wrench: cat.# 20388 $20/2-pk.

Connecting Fused Silica Tubing to Metal MXT® Tubing

MXT® tubing can be connected to fused silica tubing by using a capillary Vu-Union™ (cat. #20418) providing the end of the MXT® column is properly burnished into a conical shape. A fused silica Press-Tight® Connector cannot be used with MXT® columns because without polyimide coating on the outside of the tubing, a leak-free connection cannot be obtained. To connect a fused silica column to an MXT® column, follow the same procedure described when connecting MXT® columns to direct injection inlet sleeves with Press-Tight® tapers (page 10). Use the back, flat side of a ceramic wafer to shape the column end into a round conical taper.

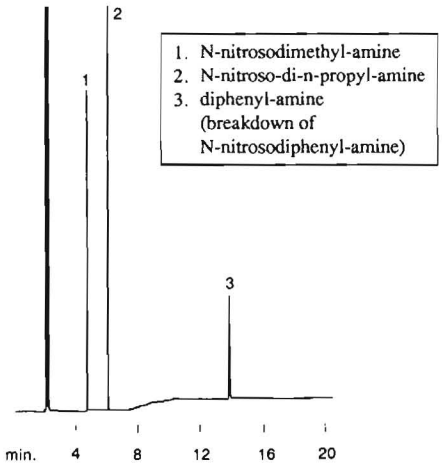
The photo below shows a microphotograph of an MXT® and fused silica capillary column connected via a Vu-Union™. Notice the tight, dead volume free connection of the MXT® column in the tapered glass insert.

Figure 16 shows a chromatogram generated by attaching a 5-meter MXT® guard column to a 30-meter fused silica column. Note the symmetrical solvent peak shape and lack of component tailing indicating a successful, leak-free connection.



An MXT® column can be connected to fused silica tubing using a capillary Vu-Union™, provided the MXT® column end is burnished in a conical shape.

Figure 16 - Symmetrical peak shapes are obtained when connecting an MXT® guard column to a 30-meter fused silica column with a Vu-Union™.



Capillary Vu-Union™

- One deactivated glass tapered insert (fits column ODs ranging from 0.35 to 0.74mm).
- One metal housing body.

cat.# 20418 each - Order ferrules separately below.

Replacement Vu-Union™ Deactivated Glass Inserts

(fits column ODs ranging from 0.35 to 0.74mm).
cat.# 20419 3-pk.

Graphite Ferrules for the Vu-Union™

for 0.53mm ID MXT® columns:
cat.# 20202 10-pk. and cat.# 20224 50-pk.

Vespel®/Graphite Ferrules for the Vu-Union™

for 0.53mm ID MXT® columns:
cat.# 20213 10-pk. and cat.# 20230 50-pk.
for 0.28mm ID MXT® columns:
cat.# 20232 10-pk.

Silcosteel®

Silcosteel® Characteristics

- Inert, flexible, and strong
- High thermal stability (400°C)
- Available in long lengths
- Priced below Glass Lined Tubing™ (GLT)

Silcosteel® Tubing is Ideal for:

- Transfer lines for purge & trap, mass spectrometers, FTIRs, and other instruments
- Sample loops and sampling lines for active compounds
- Replacing fragile glass packed columns
- On-line process chromatography

Restek's Silcosteel® is an alternative to GLT™. Silcosteel® is flexible, strong, stainless steel tubing that has a highly inert surface. Unlike GLT™, it can be bent into any configuration without heating, provided it isn't severely kinked or stretched. It can be cut with a standard tubing cutter or a high speed cut-off wheel. The inner surface of Silcosteel® can be rinsed with a variety of solvents, including water, without damaging the deactivation layer. (Rinsing with strongly acidic or basic aqueous solutions is not recommended.) Generally, Silcosteel® can be handled like fused silica tubing.

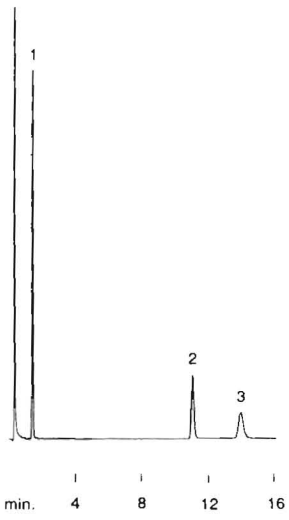
How is Silcosteel® Made?

Silcosteel® tubing is made with a unique process developed by Restek. This process uses a high temperature reaction to bond micron layers of pure, flexible fused silica directly onto the inner stainless steel surface. Then, these layers are thoroughly deactivated using the same proprietary process Restek uses to make Crossbond® capillary columns. The deactivation reagent, which contains phenyl and methyl groups, yields a highly wettable surface for both polar and non-polar compounds as discussed by Grob (Grob et. al., *J. Chromatography,* 334 [1985] pp.129-155).

Replace Fragile Glass Packed Columns with Flexible, Inert Silcosteel®

Silcosteel® is the perfect replacement for glass packed columns*. It offers a high degree of inertness and allows the flexibility often required when connecting packed columns to different detectors or instruments. Compare Figures 17 and 18. Can you tell the difference between the Silcosteel® packed column and the glass packed column when low levels of highly reactive phenols are injected? The response for 2,4-dinitrophenol and pentachlorophenol are virtually indistinguishable!

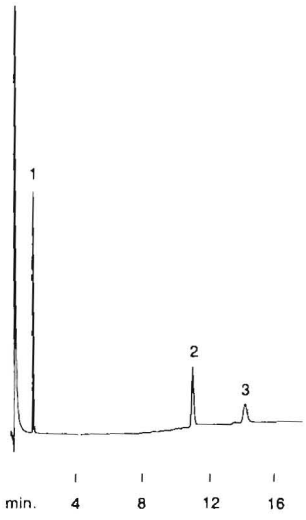
Figure 17 - An 8' x 1/8" OD Silcosteel® packed column shows exceptionally high inertness to active compounds such as 2,4-dinitrophenol and pentachlorophenol.



1. naphthalene
2. 2,4-dinitrophenol
3. pentachlorophenol

* Note, Restek provides Silcosteel® tubing for chromatographers to pack their own columns. In addition, you can order pre-packed columns from one of our many distributors.

Figure 18 - An 8' x 3mm ID deactivated glass column also shows good inertness with the active phenols, however, it is not as flexible as Silcosteel® tubing.



Answers to Commonly Asked Questions Regarding Silcosteel®:

Can Silcosteel® be bent in 90° angles?

Yes, but it is extremely important to make gentle bends with rounded corners. Sharp bends kink the tubing and crack the fused silica layer, causing a loss of inertness. Treat Silcosteel® tubing like a fused silica capillary column.

Can metal Swagelok-type fittings be tightened on Silcosteel® tubing without causing damage?

Yes, the flexible fused silica coating compresses as the fitting is tightened and the ferrule bites into the metal wall. We recommend using Silcosteel®-treated fittings to maintain the high degree of inertness.

Can Silcosteel® be spot welded?

Silcosteel® and MXT® tubing may be welded or brazed if care is taken to limit the spread of heat generated during these processes. The siloxane deactivation layer will begin to decompose at temperatures greater than 400°C (in air), but the fused silica layer should not be harmed by the temperatures required for welding or brazing. Therefore, the catalytic nature of the stainless steel will remain masked by the fused silica, but surface silanol groups may become exposed by the absence of the siloxane deactivation layer.

Can Silcosteel® be used as an inert pathway for on-line process sampling or instrument transfer lines?

Yes. Due to the high inertness of Silcosteel® tubing and fittings, it is an excellent transfer line for inert or active compounds. Silcosteel® fittings allow thousands of feet of tubing to be connected together to maintain a truly inert pathway.

Can custom items be treated with Silcosteel®?

Yes, as long as the items can withstand over 400°C and hold pressure. We routinely treat items that require sharp kinks or bends, and parts that need to be inert. We can treat nickel or other types of metal as well. Please call your local distributor for more information.

Silcosteel® Fused Silica Lined Stainless Steel Tubing

Length (in ft.)	ID 0.011″ (0.28mm) OD 0.022″ (0.53mm) cat.#	ID 0.021″ (0.53mm) OD .031″ (0.79mm) cat.#	ID 0.010″ (0.25mm) OD 1/16″ (1.6mm) cat.#	ID 0.020″ (0.51mm) OD 1/16″ (1.6mm) cat.#
6	20570	20563	20550	20524
25	20571	20564	20551	20525
50	20572	20565	20552	20526
200	20573	20566	20553	20527
>400	20574	20567	20554	20528

Length (in ft.)	ID 0.030″ (0.76mm) OD 1/16″ (1.6mm) cat.#	ID 0.040″ (1.02mm) OD 1/16″ (1.6mm) cat.#	ID 0.085″ (2.16mm) OD 1/16″ (3.18mm) cat.#	ID 0.210″ (5.33mm) OD 1/16″ (6.35mm) cat.#
6	20530	20538	20545	20555
25	20531	20539	20546	20556
50	20532	20540	20547	20557
200	20533	20541	20548	20558
>400	20534	20542	20549	20559

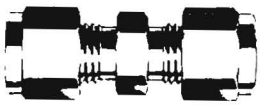
Call for availability of lengths greater than 400ft.

** Intermediate lengths are available upon request at no extra cost.*

Use Inert Silcosteel® Fittings to Connect Silcosteel® Tubing

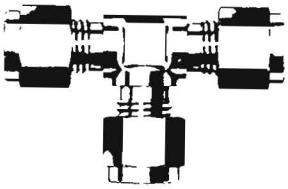
(Each fitting is deactivated and lined with a fused silica layer).

Unions



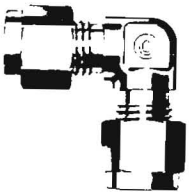
Size	cat.#
1/16"	20510
1/8"	20511
1/4"	20512

Tees



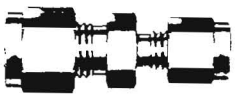
Size	cat.#
1/16"	20513
1/8"	20514
1/4"	20515

Elbows



Size	cat.#
1/16"	20516
1/8"	20517
1/4"	20518

Reducing Fittings



Size	cat.#
1/16" to 1/8"	20510
1/16" to 1/4"	20511
1/8" to 1/4"	20512

New! Straight Silcosteel® Tubing

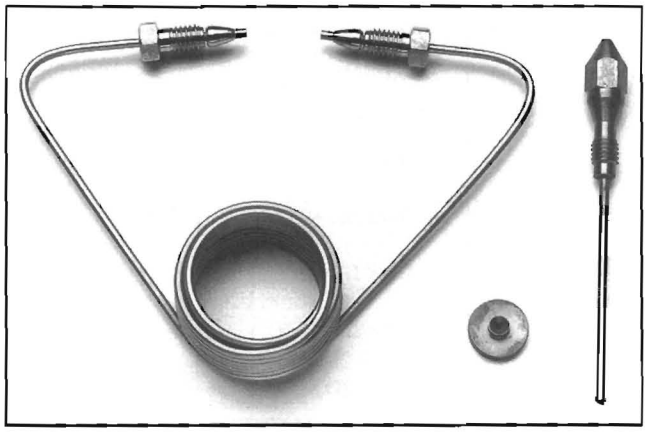
- Ideal for adsorbent traps and thermal desorption tubes
- Available in 1/8" and 1/4" ODs
- Easily cut to specific lengths

The inertness of Silcosteel® makes it ideal for the construction of adsorbent traps and thermal desorption tubes. Straight lengths of tubing are also useful for transfer lines and instrument interfaces. In response to customer requests, we now offer 18" straight lengths of 1/8" and 1/4" OD Silcosteel® tubing. This tubing can be cut to your exact requirements using a standard tubing cutter. Straight Silcosteel® is available in individual pieces or in economical 5-packs.

ID 0.085" OD 1/8" cat.#	ID 0.210" OD 1/4" cat.#
20575	20577
20576	20578

Custom Parts

Custom parts can be treated with Silcosteel® upon request. The fused silica layer is ideal for extending the life of stainless steel tubing in corrosive atmospheres such as HCL and HS gas. Metal pathways can be made inert to active chemicals such as sulphur, phenols, alcohols, glycols, and others. Injection systems, sample loops, transfer lines, detectors, jets, and any other metal part that contacts the sample stream can be passivated and rendered inert to adsorption. Call your local distributor for more information.



Instrument Grade Stainless Steel Tubing

Heat-Treated Stainless Steel Tubing

- Solvent cleaned and heat-treated to remove all volatile impurities
- Ideal for sensitive GC detectors such as ECDs, MSDs, NPDs, and FIDs that require pure carrier gas
- Perfect for concentrating inlet systems such as purge & trap or thermal desorption units
- Available in continuous lengths to minimize potential leaky detectors
- Economically priced

Heat-Treated to Eliminate Contaminants

Most stainless steel tubing contains hydrocarbon impurities that migrate into the carrier gas stream and cause background noise or ghost peaks. Solvent cleaned tubing can still contain contaminants that were either insoluble in the cleaning solvent, or left over as a residue from the cleaning process. Restek chemists found that gradient solvent rinsing, used in combination with a high temperature treatment under a flow of clean carrier gas is the best way to guarantee ultra high purity carrier gas lines. Background contamination is eliminated and new instruments can be plumbed with confidence.

Available in Longer Lengths

Tight manufacturing tolerances ensure close inside and outside dimensions. The 304 stainless steel tubing is annealed for added flexibility allowing kink free bends. Continuous lengths up to 500 feet are available to eliminate the need for connectors.*

Plumb your instrument with the best. Try Restek's heat treated, solvent cleaned, instrument grade tubing.

Top quality pre-cleaned stainless steel tubing without the expense!

Stainless Steel Tubing Dimensions	25 ft. cat.#	26-100 ft. cat.#	>100 ft. cat.#
0.01"ID, 1/16"OD	21500	21501	21502
0.02"ID, 1/16"OD	21503	21504	21505
0.03"ID, 1/16"OD	21506	21507	21508
0.04"ID, 1/16"OD	21509	21510	21511
0.085"ID, 1/8"OD	21512	21513	21514
0.21"ID, 1/4"OD	21515	21516	21517

* Please inquire before ordering to determine the availability of continuous lengths up to 500 feet. The availability of long lengths is subject to inventory constraints.

GC Accessories

Thermolite® Septa

Extensive testing has shown that Restek's Thermolite® septa has the lowest concentration of ghost peaks and exhibits the flattest baseline when compared to five leading competitor's septa. Low bleed septa are extremely important since the volatiles that emit from the septum can accumulate on the capillary column. These volatiles cause baseline rise and extraneous peaks, making component identification very difficult. This is accentuated when using splitless, on-column, or direct injection modes. The high resolving power of capillary columns makes low bleed septa even more important.

Thermolite® septa are easy to penetrate and do not fragment and tear since high quality silicone monomers are used instead of inexpensive, organic fillers. Our septa do not stick to the hot inlet or decompose while installed in the injection port. This eliminates small septa fragments from accumulating in the injection port sleeve. Therefore, less time is spent cleaning and changing inlet sleeves when high quality Thermolite® septa are used. For more information, request Restek's *Guide to Minimizing Septa Problems*.

- Lowest bleed on FIDs, ECDs, and MSDs
- Each batch is QA tested for FID bleed
- High puncturability for easy needle penetration
- Useable at 340°C inlet temperatures
- Does not adhere to hot metal injectors
- Preconditioned and ready to use, no extra conditioning required

Instrument	Septum Size
Hewlett-Packard	
5890 series	10mm/11mm
5700, 5880 series	9.5mm/10mm
Varian	
packed column injector	9.5mm/10mm
split/splitless injector	10mm/11mm
Perkin-Elmer	
Sigma series, 900, 990	11mm
8000 series	11mm
Tracor	
550, 560	9.5mm
220, 222	12.5mm
Gow-Mac (all models)	9.5mm
Fisons/Carlo-Erba	17mm
8000 series	
Pye/Unicam	7mm

Septum Diameter	25-pack *Free Can Cooler* cat.#	50-pack *Free Coffee Mug* cat.#	100-pack *Free Stein* cat.#
5mm (3/16")	20351	20352	20353
6mm (1/4")	20355	20356	20357
7mm	20381	20382	20383
9.5mm (3/8")	20359	20360	20361
10mm	20378	20379	20380
11mm (7/16")	20363	20364	20365
12.5mm (1/2")	20367	20368	20369
17mm	20384	20385	20386
Shimadzu Plug	20372	20373	20374

Receive a free can cooler, coffee mug, or stein with the purchase of Thermolite® septa!

Ceramic Scoring Wafer

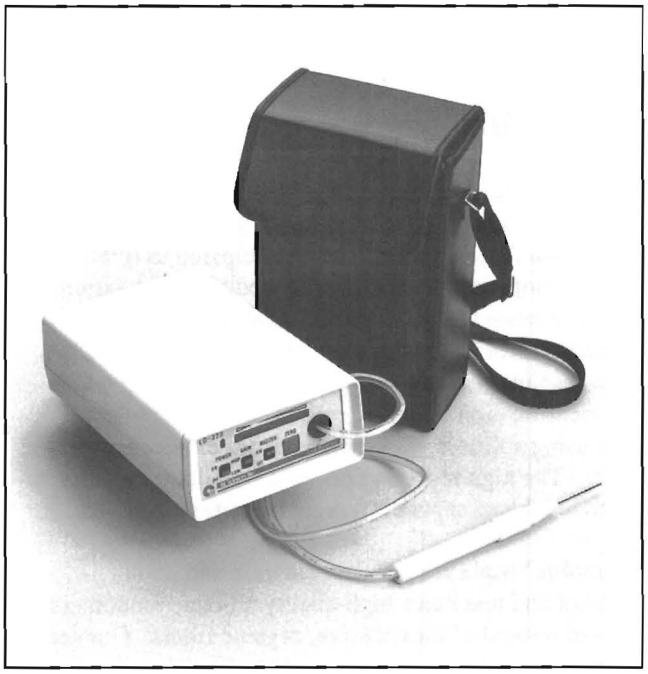
The scoring wafer has four straight scoring edges to squarely cut fused silica. It also has four serrated edges that can be used to cut metal capillary columns.

cat.# 20116, 5-pk.

GL Sciences Leak Detector

Leaks in a gas chromatographic system can cause problems ranging from increased detector noise, baseline instabilities, and short column lifetimes, to wasting expensive carrier gases. GL Sciences' new portable Leak Detector LD-223 allows analysts to detect gas leaks down to 0.01ml/min. This leak detector's compact size is designed for easy transport and hand-held usage. Simple, push button operation allows one-touch zero adjustment, while the low dead volume sampling line provides quick sample response. Trace leaks of both helium and hydrogen can be detected using the high sensitivity range. Four AA alkaline batteries (not included) provide up to 12 hours of continuous operation.

- Portable size
- Quick response
- High sensitivity
- Simple operation
- Contamination-free leak detection



cat.# 21605

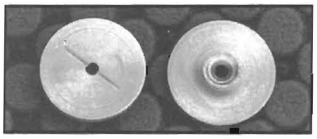
Modified Inlet Seals for HP 5890 GCs

The inlet seal at the base of the HP 5890 GC injection port comes into contact with the sample and must be changed frequently to prevent adsorption of active compounds. In addition, septa fragments and sample residue accumulate on the disk surface requiring replacement.

The seal occurs by deforming the disk against the injection port base upon tightening, forming a micro ring (as the microphotograph shows). Originally, the disks were manufactured from 303 stainless steel which did not deform will upon tightening, resulting in a small leak. The new disk design uses 203EZ stainless steel which is softer and deforms easier, making a completely leak-tight seal. (Due to the deformation of the seating surface, we do not recommend reusing inlet seals).

This new disk design increases column lifetime because oxygen cannot permeate into the carrier gas. Detector noise is also reduced with high sensitivity detectors such as ECDs or MSDs. (replaces HP part number 18740-20880.)

Replacement Inlet Seals:
cat.# 20390, 2-pk.
cat.# 20391, 10-pk.



Restek's Digital Flow Calibrator

- Calibrated against NIST Standards
- Large LED display for easy readout
- Use with all chromatography gases
- Battery operated for portability

This battery operated digital flow calibrator is designed to measure and calibrate gas flows used in capillary chromatography. The flow calibrator is capable of measuring flow rates of 0.5-50mls/min. accurately, regardless of the gas type. It is an excellent tool for measuring the split vent flow and detector gas flows, and is capable of displaying the split ratio.

cat.# 20123

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High Temp. Stability Problem Solved with New Metal Columns - Analysis of Total Glycerides in Biodiesel Oils by ASTM D-6584 Using New MXT®-Biodiesel TG Capillary Columns

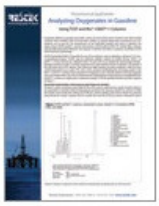
The high temperatures required for biodiesel analysis by gas chromatography present a considerable challenge to analytical columns. Fused silica columns, even those rated for high-temperature tolerance, breakdown relatively quickly. Restek's new MXT®-Biodiesel columns are more stable up to 430°C and offer excellent chromatography for glycerides. These columns are available in two configurations: factory-coupled to a 0.53mm retention gap, or with a built-in, leak-proof Integra-Gap™ retention gap.

Eliminate Column Breakage in High Temperature Biodiesel Analysis

Using metal columns to analyze glycerides in biodiesel offer significant performance advantages compared to fused silica columns, as shown in this evaluation.

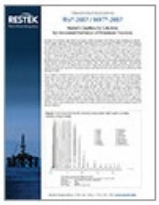
Tighten Control of Distillation Processes with the New MXT®-1HT SimDist Column

New MXT®-1HT SimDist GC columns outperform competitors, allowing more productive D6352 analyses. Here we demonstrate lower bleed levels and higher efficiency, improving resolution and assuring more samples can be run within method specifications.



Analyzing Oxygenates in Gasoline Using TCEP and Rtx-1/MXT-1 Columns

Two methods are used to quantify individual alcohols and ethers in gasoline: a single column OFID method (e.g., ASTM Method D5599-94) and dual-column ASTM Method D4815-93. Restek offers columns, calibration mixtures, and inert capillary tubing for both approaches. 4-page note. (PDF - 0MB)

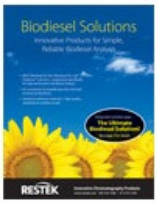


Rtx-2887 / MXT-2887: Restek's Capillary GC Columns for Simulated Distillation of Petroleum Fractions

ASTM D2887-01a is used to monitor petroleum products, excluding gasoline, with final boiling points of less than 538°C. Metal MXT-2887 columns and fused silica Rtx-2887 columns offer lower bleed, faster analysis times, and longer column lifetimes. (PDF - 0MB)

Solutions for Your Petro Analyses

Chromatograms, technical tips, and products developed specifically for petrochemical testing. Details recommendations for simulated distillation, PLOT column applications, DHA, D3606, biodiesel, permanent gases and hydrocarbons. (PDF - 4MB)



Biodiesel Solutions: Innovative Products for Simple, Reliable Biodiesel Analysis

This flyer includes data demonstrating the performance of recommended GC columns for the analysis of total glycerin, fatty acid methyl esters (FAMEs), and residual methanol in biodiesel. Features a comparison of metal and fused silica columns. (PDF - 2MB)

MXT®Capillary Columns

Stainless steel MXT® columns are your best choice for high temperature chromatography or any other situation where the potential for column breakage is too high to rely on fused silica. For field instruments, process GCs, GCs with small ovens, and more, reach for robust Restek MXT® columns! (PDF - 1MB)

Accurately Determine Mineral Oil Hydrocarbons in Food and Packaging

Accurate testing for mineral oil hydrocarbons (MOHs) in food and packaging is imperative to the safety of our food supply. Turn to Restek for the certified reference materials (CRMs), HPLC columns, GC guard columns, and GC analytical columns you need for world-class analysis of mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH) via online LC/GC coupling. (PDF - 1MB)

Get Guaranteed Method Performance With MXT®-1HT SimDist Columns

Increase lab productivity and confidence in your data. Featuring rugged Siltek®-treated MXT® tubing to eliminate breakage, all 5 m x 0.53 mm x 0.10 µm MXT®-1HT SimDist columns from Restek (cat.# 70112) are tested up to 430 °C. Performance is guaranteed to meet ASTM Method D6352-12, D7169-11, and D7500-12 requirements. (PDF - 2MB)

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MXT Columns

RESTEK 2016 GC Columns

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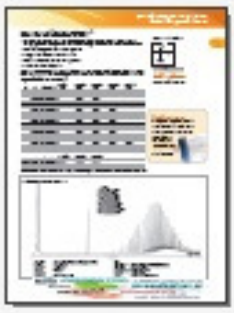
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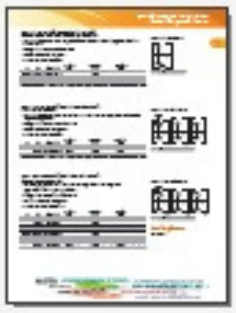
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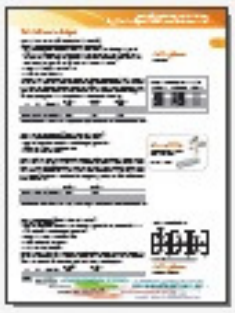
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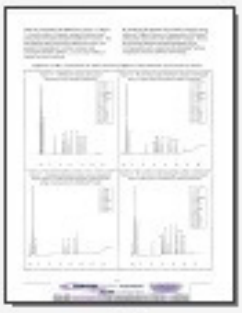
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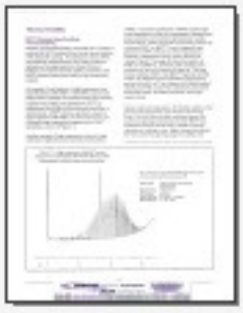
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MXT Columns

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